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The Engineer

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PUBLIC NOTICES

The High Commissioner for India is prepared to receive TENDERS for the SUPPLY of :—

WROUGHT IRON CYLINDRICAL BUFFERS, &c.

Forms of Tender may be obtained from the Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, and Tenders are to be delivered at that office not later than Two o'clock p.m. on Friday, the 7th July, 1922.

T. RYAN,
Director-General.

8485

WORKS MANAGER FOR THE NORTH-WESTERN RAILWAY CARRIAGE AND WAGON WORKSHOPS IN INDIA.

The Secretary of State for India invites APPLICATIONS for an APPOINTMENT as WORKS MANAGER for the Carriage and Wagon Shops of the North-Western Railway at Lahore, on a five years' agreement in the first instance, on salary of Rs. 1000 a month, rising by annual increments of Rs. 50 a month to Rs. 1200 a month.

Candidates should be about 36 to 40 years of age. They should have been regularly trained as Mechanical Engineers and have had subsequent experience in Carriage and Wagon Work either in a railway workshop or with a well-known firm of carriage and wagon builders. They must be well versed in the construction and maintenance of modern railway rolling stock and possess a good knowledge of modern methods of workshop management. They should have had experience in the production of duplicate parts for the repair and maintenance of rolling stock, especially high-capacity (all steel) wagons, and should be well acquainted with the latest methods of mass production of carriage and wagon details from modern manufacturing plant and high-class automatic machinery. They should also be acquainted with piecework and bonus systems of working.

They must be good organisers, strict disciplinarians, able to control labour, and should have held positions of responsibility in either a railway carriage and wagon workshop or with a contract firm of carriage and wagon builders.

Full particulars regarding the terms and conditions of appointment can be obtained from the SECRETARY, Public Works Department, India Office, Whitehall, S.W. 1, and applications for the appointment, giving full particulars of the candidate's age, education, training and experience, should reach him not later than the 15th July next.

India Office,
8th June, 1922. 8486

Finsbury Technical College,
LEONARD-STREET, CITY-ROAD, E.C. 2.

Dean for the Session 1921-22 :
Professor W. H. ECCLES, D.Sc., F.R.S.

The College provides practical scientific training for students who desire to become Civil, Mechanical or Electrical Engineers, or Chemists.

Candidates are required to pass an Entrance Examination in Mathematics and English, but the Matriculation Certificate of any British University and certain other qualifications are accepted in lieu of it. The next ENTRANCE EXAMINATION will be held on TUESDAY, SEPTEMBER 19th. Applications for admission should be forwarded to the College on forms to be obtained from the REGISTRAR. The programme of the College is under revision and will be issued shortly. 8468

University of Birmingham.
ASSISTANT LECTURER IN CIVIL ENGINEERING, GRADE II.

APPLICATIONS are INVITED for the POST of ASSISTANT LECTURER in the Civil Engineering Department. Commencing stipend £400 per annum.

A good University degree and practical experience of Constructional Engineering are essential.

Applications, with testimonials and references, should be forwarded to the undersigned not later than July 4th.

Further particulars may be obtained from

GEO. H. MORLEY,
Secretary.

8480

Bengal-Nagpur Railway Company,
LIMITED.

The Directors are prepared to receive TENDERS for the following :—

8486 TONS STEEL FLAT-FOOTED RAILS, and
2654 TONS STEEL FISH-PLATES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 14th June, 1922.

A fee of £1 1s. will be charged for the specifications, which will not be returned.

Tenders must be submitted not later than Noon on Wednesday, 28th June, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
T. R. WYNNE,
Managing Director.

8476

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to Noon on Wednesday, 5th July, TENDERS for the SUPPLY of :

1. SPRING and FERRULE STEEL.
2. WROUGHT IRON or STEEL PIPING.
3. FERRO-MANGANESE and FERRO-SILICON.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for No. 1 and 10s. each for Nos. 2 and 3 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France,
Westminster, S.W. 1.
13th June, 1922. 8473

County Borough of Halifax.
HALIFAX CORPORATION ELECTRICITY DEPARTMENT.

The Tramways and Electricity Committee of the Halifax Corporation have FOR SALE the following PLANT :—

2 Babcock and Wilcox WATER-TUBE BOILERS, complete with Chain-grate Stokers.
1 TANDEM COMPOUND STEAM FEED WATER PUMP (J. P. Hall and Son's make).

The above can be inspected by arrangement, and full particulars may be obtained on application to Mr. W. M. Rogerson, M.I.E.E., Borough Electrical Engineer, 29, Northgate, Halifax.

Tenders for the above plant should be delivered to the Town Clerk, Town Hall, Halifax, not later than Saturday, 8th July, 1922.

The highest or any Tender not necessarily accepted.

By Order,
PERCY SAUNDERS,
Town Clerk.

Town Hall, Halifax,
10th June, 1922. 8441

PUBLIC NOTICES

Bray Urban District Council.
NEW OR SECOND-HAND BOILER REQUIRED.

Notice is hereby given that the Bray Urban District Council will, at their meeting on Tuesday, 4th July, 1922, be prepared to receive and consider TENDERS for the SUPPLY and DELIVERY at Bray of a MILD STEEL VERTICAL CROSS-TUBE STEAM BOILER for Harbour Crane (new or second-hand), 7ft. high, 3ft. 6in. diameter, with two 7in. diameter cross tubes, with stop valve, safety valve, pressure gauges, water gauges, manild, cleaning doors, and all other necessary fittings and chimney complete. Boiler to be constructed for a working pressure of 180 lb. per square inch and to be tested by hydraulic pressure to 220 lb. per square inch.

The Council is not bound to accept the lowest or any Tender.

Tenders, marked "Tender for Boiler," should reach the undersigned not later than Eight o'clock p.m. on date mentioned.

J. McCAULL,
Clerk to the Council.

Town Hall, Bray,
13th June, 1922. 8490

County of London.
REPAIRS TO PAVEMENTS, BLACKWALL AND ROTHERHITHE TUNNELS.

TENDERS are INVITED for REPAIRS to the PAVEMENTS of BLACKWALL and ROTHERHITHE TUNNELS.

The specification, form of Tender, &c., may be obtained from the Chief Engineer of the Council, at Gloucester House, 19, Charing Cross-road, W.C. 2, upon payment to the Cashier of the Council of the sum of £3. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Tenders should be addressed to the Clerk of the Council and delivered at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 26th June, 1922. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.

8478

Madras and Southern Mahratta Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

GIRDER BRIDGES (One 6ft., Six 10ft., Two 22ft., and Thirty-two 60ft. Spans),

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Friday, the 30th June, 1922, marked "Tender for Girder Bridges."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1,
14th June, 1922. 8503

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.
(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.

All communications to Head Offices,
H. W. REID, 95, Belgrave-road,
General Secretary. Victoria, S.W.1.

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that CHARLES EDWARD BLYTH, subject of the King of Great Britain, Cement Manufacturer, of Stockton, near Rugby, SEEKS LEAVE to AMEND the SPECIFICATION for LETTERS PATENT No. 175,301 and entitled "Improvements in Machines for Pulverising Fuel."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 8th June, 1922.

Any person or persons may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.

The address for service is T. Fletcher Wilson, Chartered Patent Agent, High-street Chambers, Coventry. 8454

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that SPRAGUE SAFETY CONTROL and SIGNAL CORPORATION, a corporation of the State of Virginia, having a place of business at 165, Broadway, New York City, New York, United States of America, SEEK LEAVE to AMEND the SPECIFICATION for LETTERS PATENT No. 149,923 and entitled "Improvements in and relating to Train Brake Systems."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents), issued on the 8th June, 1922.

Any person or persons may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.

8469

PATENTS AND DESIGNS ACTS, 1907 AND 1919.
FLEXIBLE COUPLINGS.

The Proprietors of British Letters Patent No. 17,174 of 1912 are PREPARED to SELL the PATENT or to LICENSE British Manufacturers to work under it. It relates to a flexible coupling built up of strips or bands of textile material or thin metal.

Address :
B. W. & T.,
111 and 112, Hatton-garden,
8451 London, E.C. 1.

The South Indian Railway Company, LIMITED, are prepared to receive TENDERS for the SUPPLY of :—

1. STEEL SCREW COUPLINGS.
2. MILD STEEL.
3. SPARE PARTS for CARRIAGE UNDERFRAMES and WAGONS.
4. WHITE LEAD.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Steel Screw Couplings," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 30th June, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specifications No. 1, 2, 3, and 4.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
14th June, 1922. 8491

PUBLIC NOTICES

Metropolitan Water Board.
POSITIVE WATER METERS.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the following quantities of POSITIVE METERS :—

250 ¾in.; 100 1in.; 100 1¼in.; 100 1½in.; 50 2in.; 50 3in.

Forms of Tender and specification may be obtained from the Chief Engineer, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, by personal application (Room 150), or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board, Metropolitan Water Board, New River Head, 173, Rosebery-avenue, E.C. 1, and endorsed "Tenders for Meters," must be delivered to the offices of the Board not later than 11 a.m. on Tuesday, 20th June, 1922.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON,
Clerk of the Board.

Offices of the Board,
New River Head,
173, Rosebery-avenue, E.C. 1,
1st June, 1922. 8405

Royal Burgh of Kirkcaldy.
ELECTRICITY WORKS, VICTORIA-ROAD.

The Provost, Magistrates and Council invite TENDERS for the following WORK :—

SPECIFICATION No. 2.—CONVERTING PLANT.

A copy of the specification can be seen at and obtained from the offices of Messrs. Kennedy and Donkin, 17, Victoria-street, Westminster, S.W. 1, on and after Thursday, June 15th, upon payment of a deposit of £2 2s. (cheque, postal or money order). An additional copy of the specification can be obtained upon payment of a deposit of £1 1s. These deposits will be returned after the receipt of a bona fide Tender and on the return of the specification.

Tenders, on the prescribed form, enclosed in sealed envelopes and addressed on the outside "Electricity Supply. Tender to Specification No. 2" must be delivered at the office of the undersigned not later than 10 a.m. on Monday, 10th July, 1922.

The Council do not bind themselves to accept the lowest or any Tender.

W. L. MACINDOE, Esq.
Town Clerk's Office, Kirkcaldy,
June, 1922. 8459

SITUATIONS OPEN

A VACANCY Occurs for ONE or TWO Live ENGINEERS with electrical and mechanical knowledge, to represent one of the leading firms dealing with new and second-hand machinery. Applicants must be prepared to take up nominal holding, which is returnable. Only first-class men considered.—Address, 8356, The Engineer Office. 8356 A

BOILER SHOP SUPERINTENDENT WANTED, age between 35 and 45. Must have had previous experience in charge of boilermakers, and experience of both light and heavy work an advantage. Shop hours. Good prospects for really live man. State experience fully, age and salary expected.—Address, "SUPERINTENDENT," Wm. Porteous and Co., Advertising Agents, Glasgow. P8551 A

ENGINEER, MECHANICAL, WANTED, for Mineral Crushing and Screening Plant. Must have had experience on large scale and be capable of undertaking erecting, upkeep and repairs.—Write, stating age, whether married or single, salary required, and if any knowledge of Spanish, to "C. S. P.," c/o Street's, 30, Cornhill, E.C. 3. 8453 A

GENERAL MANAGER WANTED for Short Railway in South America (not necessarily an Engineer), not over 45 years of age, energetic, good business man, with experience in the organisation and management of traffic. Fluent Spanish essential. Good salary to suitable man.—Write, giving full particulars as to experience, to "S. A.," c/o Street's, 30, Cornhill E.C. 3. 8492 A

REQUIRED by Consulting Engineers, an ASSISTANT to specialise in Oil Well Drilling Equipment.

Applications from University graduates in mechanical engineering, who have had practical workshop experience, aged 25/26, will be considered.

Thorough knowledge of strength of materials is essential, and acquaintance with elementary practical geology will be an advantage.

Write, Box 104, c/o Dawson's, 17, Craven-street, London, W.C. 2. 8474 A

STEAM EFFICIENCY ENGINEER WANTED for a large factory in the Argentine. The applicant must have a thorough theoretical and practical knowledge of steam and be conversant with the usual recording and measuring instruments, and from the information obtained from these able to work the boiler plant efficiently and economically. One who has held a position where the economical working and scientific control of boilers and steam-using apparatus was an objective preferred.—Write, stating qualifications and salary asked, giving full particulars of scientific training and practical experience. Age not to exceed 36.—"A. E. T.," c/o Street's, 30, Cornhill London, E.C. 3. 8397 A

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SALES' ENGINEER REQUIRED, to Take Charge of Plant Sales of large Electrical Engineering Manufacturing Firm in India. First-class experience in heavy plant work and sales experience essential.—Address, 8450, The Engineer Office. 8450 A

WANTED, DRAUGHTSMAN, Having Good Knowledge of and able to design Semi-d-w Brick-making Plant, also Sand, Lime and Cement Brick and Tile Plant.—Address, stating age, experience, salary required and references, P5554, The Engineer Office. P5554 A

WANTED, ENGINEER as CHIEF DRAUGHTSMAN; must be a Rly Man, able to get out production drawings out at lowest possible cost. Experience in the administration and routine of modern drawing-offices of primary importance.—Apply, with full particulars, stating age and salary, to Drawing-office Superintendent, THE ENGLISH ELECTRIC CO., Ltd., Ordnance Works, Coventry. 8392 A

WANTED for Engineer's Drawing-office of Large Midland Manufacturers, good SENIOR DRAUGHTSMAN for Power, Piping, and General Factory Lay-outs. State fully age, experience and salary required.—Address, 8460, The Engineer Office. 8460 A

WANTED, Fully Qualified AUTOMOBILE DRAUGHTSMAN. Preference will be given to applications from men who have specialised in commercial vehicle design.—State age, experience and salary expected to Box No. C.M. 540, c/o Dawson's, 121, Cannon-street, E.C. 4. 8477 A

WANTED, London District, TWO or THREE DRAUGHTSMEN, accustomed to Lay-outs of Plants, Pipe Arrangement, Tank Work, &c.—Address, full particulars, age, experience, and salary required, 8457, The Engineer Office. 8457 A

WANTED TEMPORARILY, SEVERAL JUNIOR DRAUGHTSMEN for details. Must have had experience in Locomotive Crane Work.—Address, stating age, salary required, and when can start, 8461, The Engineer Office. 8461 A

DRAUGHTSMAN REQUIRED in Westminster Office of London contractors; accustomed to Constructional Steel Work; some knowledge of Gasworks Plant preferred. State age, salary, and qualifications.—Address, P5569, The Engineer Office. P5569 A

FOREMAN BOILERMAKER, to Take Charge of Hydraulic Pressing, Flanging and Welding Dept. of a Firm Boiler Works in the East Midlands. Previous experience in this class of work and a good knowledge of labour costs essential. Only thoroughly practical man, well up in modern methods of manufacture, need apply.—Address, stating age, experience, and salary required, 8482, The Engineer Office. 8482 A

WANTED for Chile, (1) LOCOMOTIVE MECHANIC and (2) MECHANICAL ENGINEER, with knowledge of Electrical Work.—Write, with full references and qualifications, to "L.," c/o Street's, 30, Cornhill, E.C. 3. 8475 A

SITUATIONS WANTED

WANTED by Civil Engineer with University qualification and one year's experience on railway in British Isles, POST as ASSISTANT or DRAUGHTSMAN; first-class testimonials; 26 years.—Address, P5554, The Engineer Office. P5554 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M. 613, c/o Deacon's, Leadenhall-st., E.C. 8494 B

CHEMIST and METALLURGIST (30). B.Sc., M. Met., DESIRES responsible POSITION, ferrous or non-ferrous. Several years' experience laboratory and "melting" by crucible and electric processes.—For details and testimonials, address, P5548, The Engineer Office. P5544 B

CIVIL ENGINEER (Irrigation and Inland Navigation), 40; Scottish commissioned war service, experience Canada, India, and Mesopotamia. Testimonials state high technical attainments, trustworthy, tactful, steady, organiser, &c.—Address, P5522, The Engineer Office. P5522 B

ENGINEER, at Present in Charge of Engines and Babcock's boilers and power-house plant, SEEKS a POST abroad, Brazil or South America; can speak Portuguese and Spanish; first-class testimonials and engineer certificates.—Address, P5572, The Engineer Office. P5572 B

ENGINEER DESIRES POSITION in London or Midlands office. Wide experience of steam engine, factory and railway work; 3 years' general consulting engineering practice.—Address, P5518, The Engineer Office. P5518 B

ENGINEER, Late Manager Small London Works, with 30 years' experience of general engineering, SEEKS any responsible POST, anywhere. Moderate salary, good references.—SNOAD, 36, York-road, Hitchin.

ENGINEER-MILLWRIGHT, 27 Years' Experience, 1st Class B.O.T., SEEKS POSITION as Works Engineer, taking charge of steam power plant and maintenance, engines, turbines, boilers, pumps, and all classes of machinery, including paper mill plant. Good references.—Address, P5548, The Engineer Office. P5548 B

ENGINEER (28), Single, 14 Years' Practical Exp., expert gas and oil engines, mod. draughtsman, DESIRES POST abroad as Maintenance Engineer.—Address, P5559, The Engineer Office. P5559 B

ENGINEER (29), 1st Class B.O.T. Certificate, 7 years with leading steamship line, experienced in turbines, boilers, oil fuel, I.C., steam, electrical work, REQUIRES POSITION of Maintenance Engineer, in or near London.—Address, P5547, The Engineer Office. P5547 B

ENGINEER (30), Married, Ex-Service, Public School education, 12 years' practical and commercial experience, England and America, shop management, steam, internal combustion, electric, maintenance of factory plant, knowledge of refrigeration, accounts, typing, general office work, DESIRES POSITION, any capacity; moderate salary.—Address, P5555, The Engineer Office. P5555 B

ENGINEER (38), Now Holding Position as Sales and commercial manager, with twenty years' experience in manufacture, design, sale, and distribution of agricultural implements, tractions, tractors, threshers, electric light plants, engines (steam and internal combustion, including semi-Diesel), dairy machinery, &c., DESIRES CHANGE during current year.

Will submit full particulars in strict confidence to interested firms.

Advertiser has a clean and progressive record and seeks responsible post with good firm. Is well known throughout the United Kingdom purchasing trade, as also European and South American markets. Can without doubt use such connections in a new post.

Address, "TECHNICAL," Wm. Porteous and Co., Advertising Agents, Glasgow. P5477 B

GRADUATE, Concrete Institute (23), SEEKS POSITION with structural engineer, contractor or surveyor (all instruments). Public school, 2½ years' civil engineering training, ex-Service (lt. in D.). Blue prints of own design could be sent.—Address, P5567, The Engineer Office. P5567 B

NAVAL OFFICER (37) WISHES to SUPPLEMENT PENSION on retirement. Fair knowledge fishing, shooting, sailing, motoring, &c. Would like almost any outdoor employment at small salary; Eastern Counties preferred. Has also considerable knowledge of engineering, with large experience on both practical and educational side, and would accept suitable civil appointment.—Address P5574 The Engineer Office. P5574 B

SITUATIONS WANTED (continued)

PRACTICAL ENGINEER (39), B.O.T. Cert., Large experience maintenance and running of general machinery, boiler and power plants; 6 years maintenance engineer, chemical works, full charge, plant and men, DESIRES POSITION in charge of maintenance.—Address, P5549, The Engineer Office. P5550 B

RETIRED ENGINEER and BOILER WORKS MANAGER, with extensive connections with collieries, &c., OPEN to REPRESENT any FIRM engaged in this class of work.—Address, P5553, The Engineer Office. P5553 B

TWO DIESEL USERS.—Electrician or Engineer and Mate; first completed installation M.A.N. submarine type; disengaged June 30th; excellent references.—C/o INNESS, 16, Beech Grove-terrace, University-road, Leeds. P5536 B

ADVERTISER, a Thoroughly Skilled Mechanical Draughtsman and Designer, with long experience, DESIRES early ENGAGEMENT in London area. Accustomed to power station plants and general engineering. Highest references.—Address, P5575, The Engineer Office. P5575 B

TRACER, Young Lady, Fully Experienced, SEEKS RE-ENGAGEMENT; thorough knowledge drawing-office work and routine; good letterer, neat and accurate; excellent references.—Address, P5540, The Engineer Office. P5540 B

AS FOREMAN or WORKS MANAGER; 14 Years' experience instruments, 2½ years foreman and rep. typewriters and gramophones; well up in lay-out of works and office.—Address, P5576, The Engineer Office. P5576 B

FOUNDRY FOREMAN or WORKING FOREMAN DESIRES RE-ENGAGEMENT, home or abroad; fully experienced, good knowledge of Spanish.—Address, P5542, The Engineer Office. P5542 B

SMITHING AND DROP FORGING.—ADVERTISER SEEKS RE-ENGAGEMENT; 30 years chief foreman of smiths' shop and drop forging plant at L. and N.W. locomotive works, Crewe; later experience at Coventry with drop hammer of 12 tons, turning out stampings up to 5½ cwt.; sound reference.—Address, DAVENPORT, Radnor Cottage, Bray's-lane, Coventry. P5542 B

TOOL-ROOM or MACHINE SHOP FOREMAN (42), disengaged; thoroughly skilled mechanic with 16 years' direct tool-room experience, conversant with modern methods of production; jigs, tools, designs, &c., a speciality.—E. WAINWRIGHT, 29, Princess-street, Coventry. P5573 B

WANTED, POSITION as BRASS MOULDER; 14 years' practical experience in green and dry sand work, melting and mixing metal.—Write, MOULDER, c/o Smith's Library, Slough. P5570 B

BOILERMAKER (Improver) SEEKS Responsible SIT; good technical education, with first-class exp. on all types of land boilers and general constructional work; age 29.—Address, P5516, The Engineer Office. P5516 B

GENERAL JOBBING Green and Dry Sand MOULDER; 20 years' experience, would TAKE A CHANGE; accustomed to piecework in iron and steel foundry castings.—Address, P5526, The Engineer Office. P5526 B

MECHANIC (29), Single, Strong, Healthy, Good education, practical and theoretical training, good fitter and turner, conversant with steam, electric, hydraulic and pneumatic power, machine shop practice, general repairs and maintenance, plant installation, cold storage, heating, ex-Service, disengaged, SEEKS APPOINTMENT, home or abroad; knowledge French.—Address, P5556, The Engineer Office. P5556 B

PIPE BENDER (Blacksmith). Bend up to 17in.; steady, reliable, accurate bender, with 18 years' exp. on first-class work.—BROWNLEE, 24, Shawpark-street, Glasgow. P5566 B

TOOLMAKERS.—LAD (18) REQUIRES SITUATION as Improver in Tool-room; 3 years' experience.—E. ANSTEY, 9, Florian-road, Putney, S.W. 15. P5568 B

HEAD STOREKEEPER SEEKS a POSITION. Competent and reliable, good organiser and thorough knowledge whole routine of stores work, including management of staff; honest and trustworthy, strict disciplinarian.—Address, P5543, The Engineer Office. P5543 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.

46, Walling Street, London, E.C. 4.

Established nearly Fifty Years.

EXTRA CAPITAL.—£2000 to £10,000 OFFERED for Partnerships and Directorships in really well-established Businesses in town and country for not less than £2000. June List of Investors sent, showing capital available and businesses required.—OFFICERS' PARTNERSHIP GUARDIAN, 176, Victoria-street, S.W. 1. FOR ALL EDUCATED MEN. Call. 8444 C

EDUCATIONAL

CORRESPONDENCE COURSES for Inst. C.E., Inst. Mech. E., London Univ. (Matric., Inter., and B.Sc.) personally conducted by Mr. TREVOR W. PHILLIPS, B.Sc. (Honours), Assoc. M. Inst. C.E., M.R.S.I., F.R.S.A., &c. Also Day Tuition in Office. Excellent results at all Exams. Courses may commence at any time.—8/11, Trafford Chambers, 58, South John-street, LIVERPOOL. Ex.

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. P. KNOWLES, M.R.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Thousands of successes during the past sixteen years. Courses can be commenced at any time.—39, Victoria-street, Westminster, S.W. Telephone No., Victoria 4780. Ex.

LEARN SURVEYING AND LEVELLING.—Thorough practical instruction given by an expert.—Address, E. MOUL (late L.S.W. and S.P.D. Rlys.), Hollybank, Woking. P5475 B

FOR HIRE

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For continuation of For Sale Advertisements, see page iii.

The Case for the Economiser.

By JULIUS FRITH, M.Sc., M.I.E.E., M. Cons. E.

MANY problems regularly met with in engineering practice are made the subject of "opinions," or at best are dealt with by empirical methods and rule-of-thumb formulæ, often culled from manufacturers' catalogues. Most of these problems, however, can be solved by the rigid application of quite simple first principles and without the aid of higher mathematics.

One of the best examples of this fact is the problem of the feed-water heater or "economiser." As a result of tackling this problem in a scientific spirit, several quite interesting results are brought to light. For example, such an appliance, although it is always an economiser of fuel, is shown to be very often quite the reverse of money, large tracts of the curves of net saving—as shown hereafter—being below the zero, indicating a net loss. Again, it is generally accepted that it is more profitable to install an economiser the higher the load factor of the plant, but it is not generally known that there are certain load factors at which no conceivable economiser can possibly give anything but a dead loss. The catalogue of one notable manufacturer gives a formula which purports to yield the correct size for a feed-water heater, which formula takes no account at all of the load factor. It comes very near the truth at load factors of about 25 per cent., but at 20 per cent. load factor one of half the size would give 25 per cent. more net saving, with, of course, half the first cost. At rather lower load factors, the formula would result in an irretrievable loss.

The calculation of the size of economiser to give the best results under any given set of conditions involves only a knowledge of the quantities enumerated below, namely :—

The percentage load factor under which the plant will operate .. .. = L
The initial temperature of the flue gases as they would enter the proposed economiser chamber, deg. Fah. .. .. .. = T
The initial temperature of the feed water as it would enter the economiser, deg. Fah. = t
The pounds of steam raised per pound of coal burnt at full load without any feed-water heating .. .. = S
The pounds of flue gas per pound of coal burnt at full load .. .. = F
The cost of a ton of coal in pounds = K
The gross calorific value of the coal in B.Th.U. per pound .. .. = C
The cost in pounds of an economiser with scraper gear, &c., complete, per square foot of area .. .. = l
Percentage interest charged on capital = I
Percentage depreciation or sinking fund = D

The thermal conductivity of the feed-water tubes expressed in B.Th.U. sent through from the flue gas to the feed water per hour per square foot per degree Fahrenheit difference of temperature between the flue gas and the feed water is about 3, or possibly a little higher when the tubes are new and clean. The specific heat of the flue gases is about 0.24.

The function of the economiser is to heat the feed water and to relieve the coal burnt in the boiler from this service. Let the feed water be heated N deg. Fah. by the flue gases.

For each pound of steam raised without an economiser $\frac{1}{S}$ lb. of coal will be burnt. The economiser will reclaim N B.Th.U. for each pound of water evaporated, which is equivalent to $\frac{N}{C}$ lb. of coal, so that with the economiser the pounds of coal burnt per pound of steam raised $= \frac{1}{S} - \frac{N}{C}$, making $F\left(\frac{1}{S} - \frac{N}{C}\right)$ lb. of flue gas. This flue gas will fall in temperature in the process $\frac{N}{.24\ F\left(\frac{1}{S} - \frac{N}{C}\right)}$ deg. Fah. The average difference between the temperature of the flue gas and that of the feed water will be—

$$\left(T - \frac{N}{.48\ F\left(\frac{1}{S} - \frac{N}{C}\right)}\right) - \left(t + \frac{N}{2}\right)$$

The area of the surface of the feed water tubes required to cause N B.Th.U. per hour to pass from the flue gases to the feed water with the above temperature difference is—

$$3\left(\left(T - \frac{N}{.48\ F\left(\frac{1}{S} - \frac{N}{C}\right)}\right) - \left(t + \frac{N}{2}\right)\right)$$

The annual charge on an economiser of this size for interest and depreciation is—

$$\frac{I + D}{100} \times l \times 3\left(\left(T - \frac{N}{.48\ F\left(\frac{1}{S} - \frac{N}{C}\right)}\right) - \left(t + \frac{N}{2}\right)\right) = \frac{(I + D)\ l\ N}{300\left(T - \frac{S\ C\ N}{.48\ F\ (C - S\ N)} - t - \frac{N}{2}\right)}$$

The annual value of the coal saved depends on the load factor. For every pound of steam raised per hour at full load, it equals :—

$$\frac{N}{C} \times \frac{8766}{2240} \times K \times \frac{L}{100} = .039\ \frac{N\ K\ L}{C}\ £ \text{ per annum.}$$

The net annual saving for each pound of steam raised per hour at full load is the difference of these two, namely :—

$$N\left(.039 \times \frac{K\ L}{C} - \frac{(I + D)\ l}{300\left\{T - \frac{S\ C\ N}{.48\ F\ (C - S\ N)} - t - \frac{N}{2}\right\}}\right)$$

The foregoing will perhaps be made clearer by a numerical example, for which purpose let—

T = 500 deg. Fah. flue gas temperature.
t = 60 deg. Fah. feed-water temperature.
S = 7 lb. steam per pound coal.
F = 20 lb. of flue gas per pound coal.
K = £2 per ton coal.
C = 12,500 B.Th.U. per pound.

(1) Temperature through which the feed water is raised by the economiser = N deg. Fah.	(2) Coal saved, lb. per hour = $\frac{1000\ N}{12{,}500}$	(3) Coal burnt = $\frac{1000}{7}$ − (2)	(4) Drop in flue gas temperature = $\frac{2{,}600{,}000\ N}{1786 - N}$	(5) Average flue gas temperature = 500 − ½ (4).	(6) Average feed-water temperature = $60 + \frac{N}{2}$	(7) Average temperature difference = (5) − (6).	(8) Size of economiser = $\frac{333\ N}{(7)}$ sq. ft.	(9) First cost of economiser, (8) × 0.5. £.	(10) Annual cost for interest and depreciation = (9) × $\frac{17}{100}$	(11) Value of coal saved, £ p.a. = 0.78 × (2).	Net saving, £ p.a.	Value of coal saved, £ p.a. = 1.56 × (2).	Net saving, £ p.a.	Value of coal saved, £ p.a. = 2.34 × (2).	Net saving, £ p.a.	Value of coal saved, £ p.a. = 3.12 × (2).	Net saving, £ p.a.	Value of coal saved, £ p.a. = 3.9 × (2).	Net saving, £ p.a.	Value of coal saved, £ p.a. = 7.8 × (2).	Net saving, £ p.a.
										10 per cent. L.F.		20 per cent. L.F.		30 per cent. L.F.		40 per cent. L.F.		50 per cent. L.F.		100 per cent. L.F.	
0	0	143	0	500	60	440	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	4	139	75	463	85	378	44	22	3.8	3.1	− .7	6.3	2.5	9.4	5.6	12.6	8.8	15.6	11.8	31.3	27.5
100	8	135	154	423	110	313	106	53	9.0	6.3	− 2.7	12.6	3.6	18.8	9.8	25.2	16.2	31.3	22.3	62.5	53.5
150	12	131	240	380	135	245	203	102	17.4	9.4	− 8.0	18.8	1.4	28.0	10.6	37.6	20.2	47	29.6	94	76.6
200	16	127	328	336	160	176	380	190	32.4	12.5	− 19.9	25.2	− 7.2	37.5	5.1	50.4	18.0	62.5	30.1	125	92.6
250	20	123	425	288	185	103	810	405	69	15.6	− 53.4	31.6	− 37.4	47	− 22	63.2	−5.8	78	9	156	87

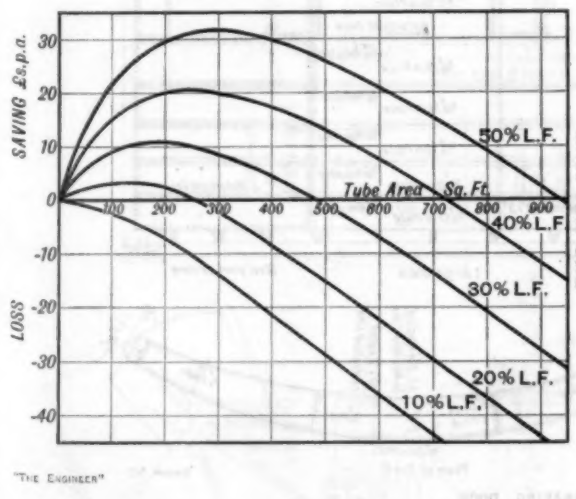


FIG. 1

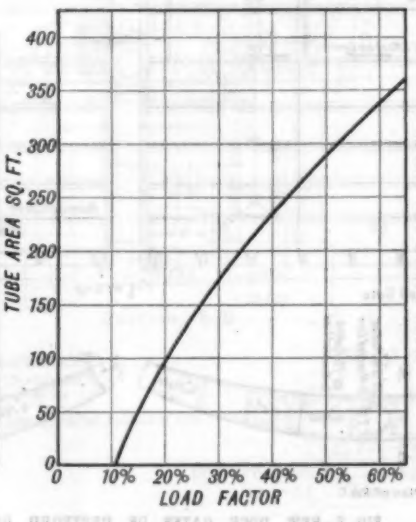


FIG. 2

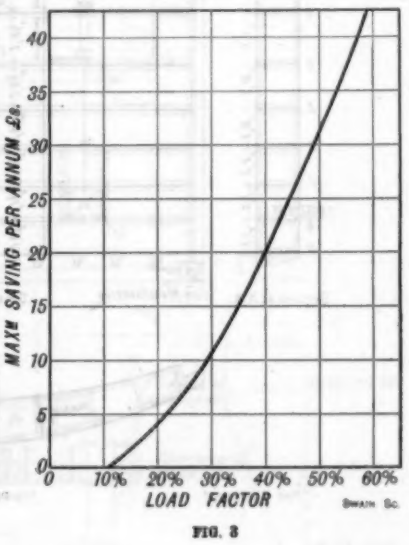


FIG. 3

l = 10s. per square foot = .5 £.
I = 10 per cent. interest.
D = 7 per cent. depreciation, which allows for a life of about ten years.

Arbitrary values of N from 0 to 250 by steps of 50 are entered in the left-hand column of the accompanying table. To make the figures reasonable, take 1000 lb. of water evaporated per hour. The heat saved in the economiser is then 1000 N B.Th.U. per hour at full load.

In the second column the coal saved per hour at full load = $\frac{1000\ N}{12{,}500}$ lb. is shown, while the figures in the third represent the coal burnt per hour, also at full load, which would be $\frac{1000}{7} = 143$ with cold feed water, and is $143 - \frac{N}{12.5}$ with the feed water heated N deg. Fah.

Taking the former expression for the drop in temperature of the flue gases and putting in the numerical values above, the expression simplifies to $\frac{2{,}600{,}000\ N}{1786 - N}$ deg. Fah. The average flue gas temperature is obtained by subtracting half this figure from 500, and the average feed-water temperature by adding $\frac{1}{2}$ N to 60. The average temperature difference is the difference of these two quantities.

The size of the economiser is obtained by dividing the total heat sent through its tubes per hour by the difference of temperature inside and outside its tubes and by the figure 3—the B.Th.U. per hour per square foot per 1 deg. Fah. difference. The first cost is this figure multiplied by .5 £ per square foot. Ten per cent. interest and 7 per cent. depreciation are together $\frac{17}{100}$ of this figure.

The coal saved at 100 per cent. load factor would, of course, be the value of the coal used per hour, multiplied by 8766, the hours in a year = 7.8 × Col. (2), and the net saving is this quantity minus the annual charge for interest and depreciation on the first cost of the economiser.

The value of the coal saved at other load factors is proportional to the load factor, and the net saving is obtained in the same way as that explained above.

The net saving appearing as a negative quantity indicates that there is in these cases an annual loss.

The results are plotted in Fig. 1, which shows the relation between size of economiser and net saving or net loss, each curve being for a different load factor, but all for a maximum of 1000 lb. of steam raised per hour. This diagram shows very clearly that there is a best size of economiser for each load factor. In Fig. 2 this best size is plotted against load factor. The peculiar feature of this curve is that it cuts the line indicating an economiser of zero size at a load factor of about 10 per cent., showing that for the particular set of conditions chosen, no economiser can possibly be a paying proposition at load factors under 10 per cent.

This is such a striking and valuable result that it is worth while to go back to the expression giving the net saving in terms of the load factor and attempt to obtain a general expression for the load factor, below which no economiser can pay. For this purpose, let us examine the expression for the net saving due to the economiser—

$$\text{Net saving} = N\left(\frac{.039 \times K \times L}{C} - \frac{(I + D)\ l}{300\left(T - \frac{S\,C\,N}{.48\,F\,(C - S\,N)} - t - \frac{N}{2}\right)}\right)$$

We wish to use this expression to find the limiting value of L below which no economiser can pay. At that limiting condition the whole expression equals zero, which occurs when the two expressions inside the big brackets are equal. Merely giving effect to this condition, however, would give many values for L involving N, which is the amount the feed water is heated, and is, therefore, a measure of the size of the economiser. Now, in the limit we are considering no economiser can pay, and therefore the appropriate size for the economiser is zero. To give effect to this latter fact we must write N = 0. The expression then becomes—

$$\frac{.039\ K\ L}{C} = \frac{(I + D)\ l}{300\ (T - t)}$$

or—

$$L = \frac{C \times l \times (I + D)}{11.7\ K\ (T - t)}$$

This is quite a simple expression, containing only $\frac{l\,C}{K}$, the cost of economiser, divided by the cost of coal on a basis of calorific value, and $\frac{I + D}{T - t}$, the capital charges divided by the initial difference of temperature of the flue gases and the feed water.

Taking the same numerical values as in the example worked out above, the least possible load factor at which it could pay to install any economiser—

$$= \frac{.086 \times .5 \times 17 \times 12{,}500}{2 \times 440} = 10.3 \text{ per cent.}$$

In Fig. 3 the same example is plotted, but giving the maximum possible saving—for 1000 lb. of steam per hour at full load—for any load factor.

The Enlargement of Deptford Dock, Sunderland.

THE old Deptford Graving Dock at Sunderland, which belongs to the firm of Sir James Laing and Sons, Limited, has recently been enlarged and reconstructed. It is interesting to note that this firm is the oldest shipbuilding firm on the river Wear, it having been founded in the year 1793, by Mr. Philip Laing, and that the business has been carried on in the present Deptford Yard since 1818. The Deptford Shipbuilding Yard is on the south bank of the Wear; it has a frontage to the river of about 2320ft. and covers an area of about 17 acres, with five building berths for large vessels. The firm owns two graving docks, one being the small Deptford Dock just referred to, and the other the Cornhill Dock, a somewhat larger one, on the north side of the river, and directly opposite to the Deptford Yard, as shown by the key plan—Fig. 1. In 1913 Messrs. Laing decided to carry out extensive alterations to Deptford Dock and had plans prepared for that purpose. The old dock was constructed of timber, both as regards the sides and the floor, but it had masonry entrance walls and sill, and

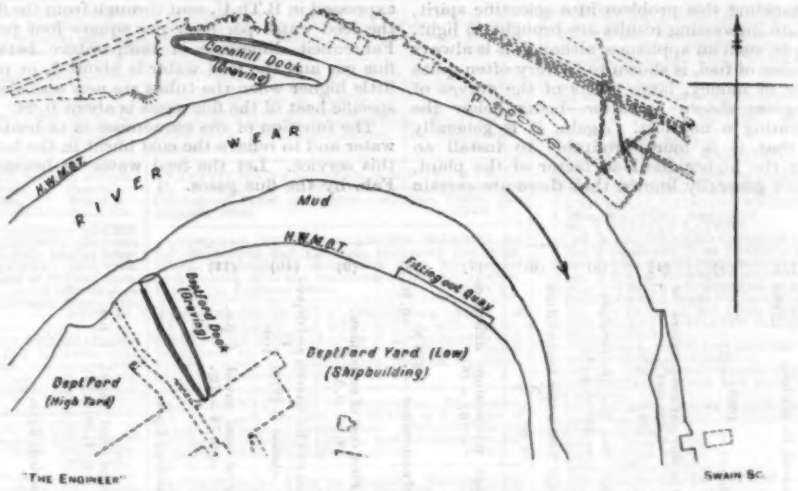


FIG. 1—PLAN SHOWING POSITION OF DEPTFORD SHIPBUILDING YARD AT SUNDERLAND

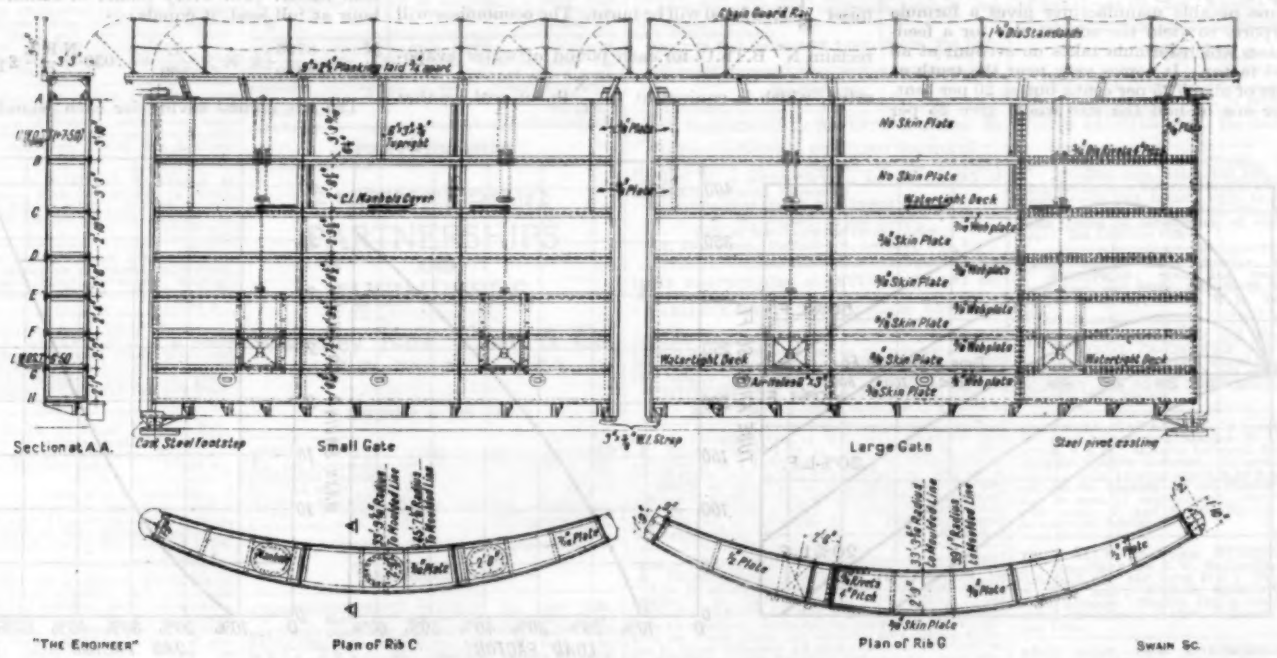
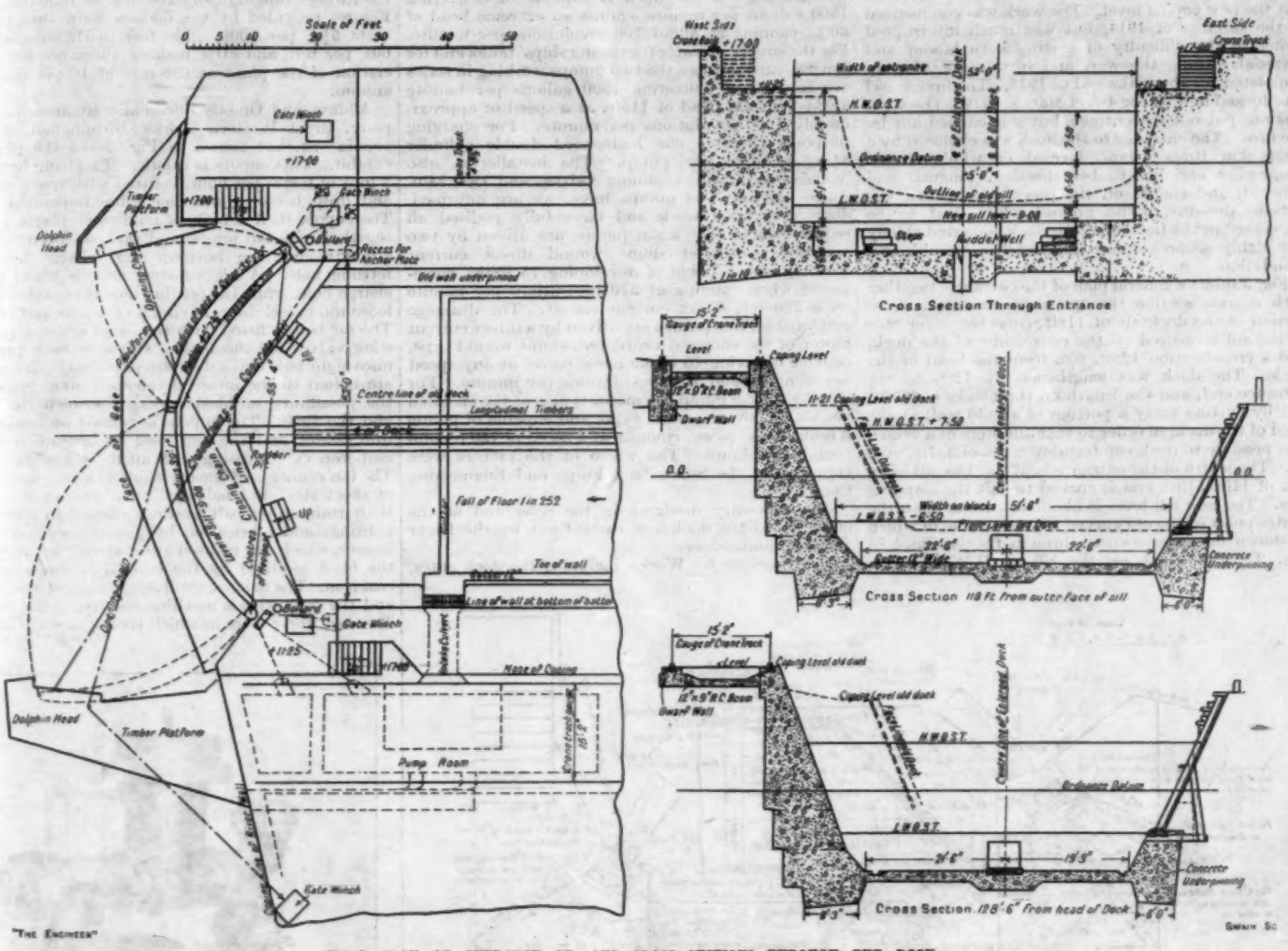


FIG. 2—NEW DOCK GATES OF DEPTFORD GRAVING DOCK

was closed by an iron floating caisson of the ship type. Incidentally, it may be mentioned that the Cornhill Dock is also a timber structure, and that in 1914 the firm had complete contract plans prepared for its enlargement, having gone so far as to receive tenders in the November of that year for carrying out the work, but owing to the war conditions it was not proceeded with.

The work of reconstructing the Deptford Dock consisted in lengthening it, widening it on the west side, and deepening it. The alterations involved the building of a new wider and deeper entrance, and a new west wall for its entire length; the underpinning with concrete of the timber work on the east side; the laying of a concrete floor; the construction and erection of new steel gates; and the building of a new

ENLARGEMENT OF THE DEPTFORD GRAVING DOCK AT SUNDERLAND



"THE ENGINEER" SWAIN Sc

FIG. 3—PLAN OF ENTRANCE OF, AND CROSS SECTIONS THROUGH THE DOCK

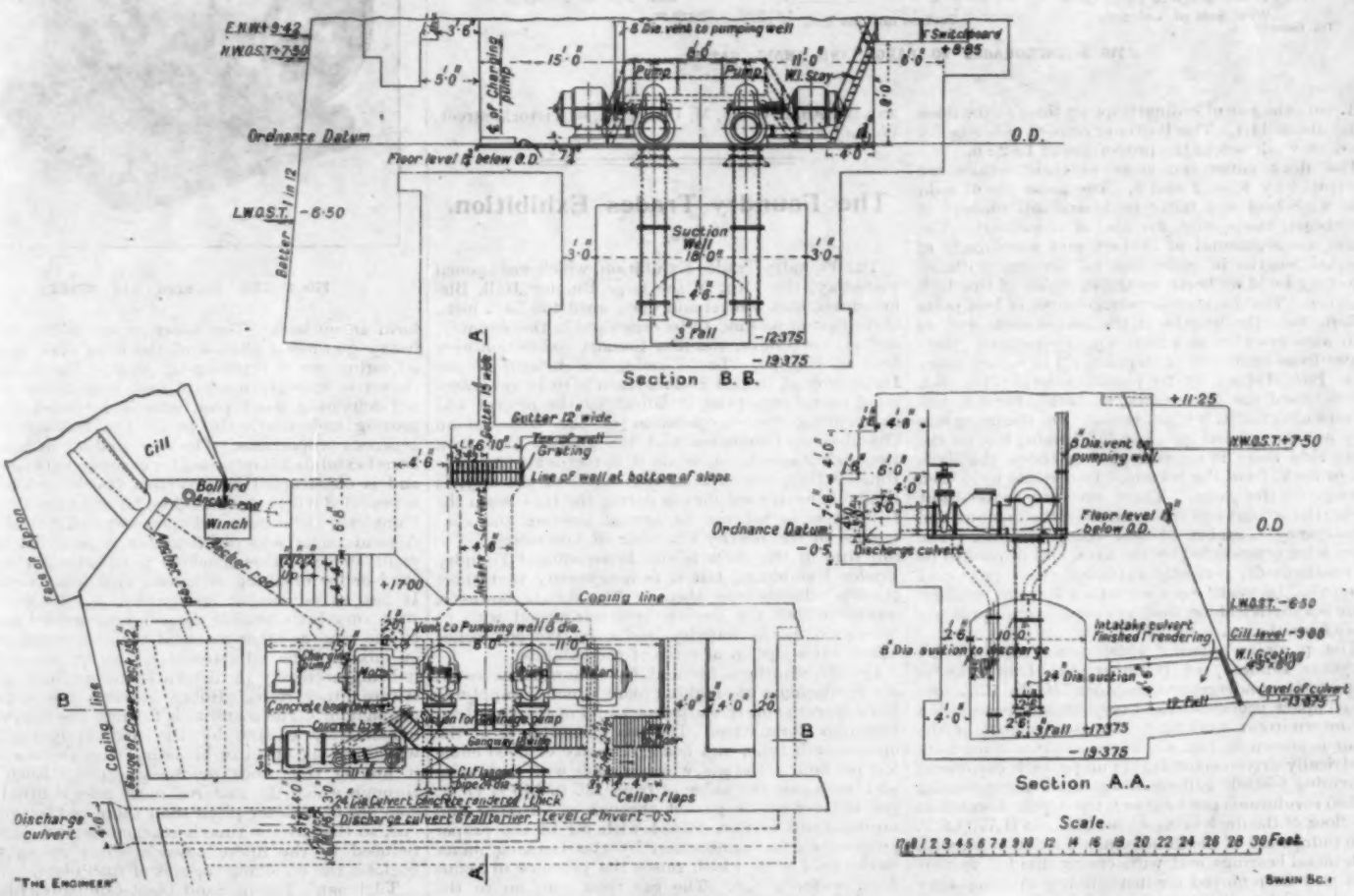


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FIG. 4—ARRANGEMENT OF PUMPING PLANT

underground pump-room and the installation of new pumping machinery. A length of new river wall was also built on the west side of the dock entrance, and the ground on the west side of the dock was raised to suit the new coping level. The work was commenced in the summer of 1914, but was much interrupted owing to the difficulty of getting both labour and materials during the war, and it was not entirely completed till about the end of 1918. The first vessel was docked in it on the 4th of March, 1919. The work was not put out to contract, but was carried out by the firm. The entrance to the dock was enclosed by a single-skin timber dam, formed of whole timber gauge-piles and half-timber sheeting, tongued and grooved, and shored on the inner side against the outside pressure. The ground which had to be excavated in the bottom of the dock consisted chiefly of a highly calcareous marl and was very suitable as a foundation.

Fig. 3 shows a general plan of the entrance, together with a cross section through the entrance, a cross section of the dock about 118ft. from the outer face of the sill measured on the centre line of the dock, and a cross section 128ft. 6in. from the head of the dock. The dock was lengthened by 12ft. at the entrance end, and the length on the blocks is 330ft., but by cutting away a portion of an old wall at the head of the dock, in order to take the stem of a vessel, it is possible to dock comfortably a vessel 337ft. over all. The width of the entrance is 52ft. The sill has a rise of 14ft. 5½in., and is curved to suit the clapping sills. The new sill level is about 3ft. lower than the centre point of the old curved sill, an outline of which is shown on cross section through the entrance in Fig. 2. The depth on the sill at H.W.O.S.T. is 16ft. 7in., the rise of ordinary spring tides at the dock being about 14ft. The Portland cement concrete for the dock-work was in the proportion of 1 : 2 : 6.

The dock gates and some of their details are illustrated by Figs. 2 and 5. The gates are of mild steel with heel and mitre posts and sill timbers of greenheart, the quoins are also of greenheart. The leaves are segmental in outline, and were made of unequal lengths in order not to interfere with an adjoining building berth on the east side of the dock entrance. The distance between centres of heel-posts is 55ft. 4in., the lengths of the leaves measured on their axes are 37ft. and 30ft. 6in., respectively, their height from underside of clapping sill to top of upper deck 19ft. 10⅜in., or to platform level 21ft. 6in. When closed the outer faces, or backs, form a continuous arc of 33ft. $3^{11}/_{16}$in. radius. On the inner side they are skin-plated for their full height, but on the outer side there is no skin-plating above the sixth rib, or deck, from the bottom. Iron rivets were used throughout the gates. There are two water-tight decks, the second and the sixth from the bottom, and a buoyancy chamber of four compartments. The gates were constructed by the firm, and proved to be an excellent fit, perfectly water-tight and quite easy to move. In warm weather with a hot sun on them there is a slight leakage due to expansion and springing away from the sill.

The pumping plant, which was supplied by Gwynnes Limited, of Hammersmith Ironworks, is housed in an underground chamber 34ft. by 12ft., and is a compact, economical and very efficient installation for intermittent working. The arrangement of the plant is shown in Fig. 4. There are two main 24in. electrically driven centrifugal pumps, each capable of delivering 650,000 gallons of water per hour running at 330 revolutions per minute; the depth of water on the floor of the dock being about 21ft., at H.W.O.S.T. The pumps are of the double inlet suction type, with gun-metal bearings, and with casing divided so that half may be removed for inspection purposes; they are designed to deliver against a varying head at a constant speed without overloading the motors. An efficient system of lubrication is provided. The drainage and ballast set consists of two 8in. twin centrifugal pumps, one of which working singly on the drainage of the dock is capable of delivering 1300 gallons per minute against an extreme head of 30ft., running at about 700 revolutions per minute. For the supply of water for testing ships' tanks and for general yard services the two pumps working in series are capable of delivering 1300 gallons per minute against a total head of 115ft. at a speed of approximately 1000 revolutions per minute. For charging purposes there is one high-speed double cylinder 4½in. by 2¾in. air pump. The installation also included two 24in. retaining valves, and two 24in. sluice valves. The pumps have, we are informed, done very good work and have fully realised all requirements. The main pumps are driven by two enclosed ventilated shunt wound direct current motors, each capable of developing 75 brake horse-power when running at 330 revolutions per minute on a 220-volt direct current circuit. The drainage and yard service pumps are driven by a direct current motor of the enclosed ventilated, shunt wound type, capable of giving 70 brake horse-power at any speed between 775 and 1000 revolutions per minute. For driving the air pump the motor is also of the enclosed ventilated, shunt wound type, and capable of giving 5 brake horse-power running at a speed of 750 revolutions per minute. The whole of the motors were supplied by the Sunderland Forge and Engineering Company.

The necessary dredging in the river and at the entrance to the dock was carried out by the River Wear Commissioners

The Engineer for Works, including the dock gates, was Mr. Adam Scott, M. Inst. C.E., of Victoria-street, Westminster.

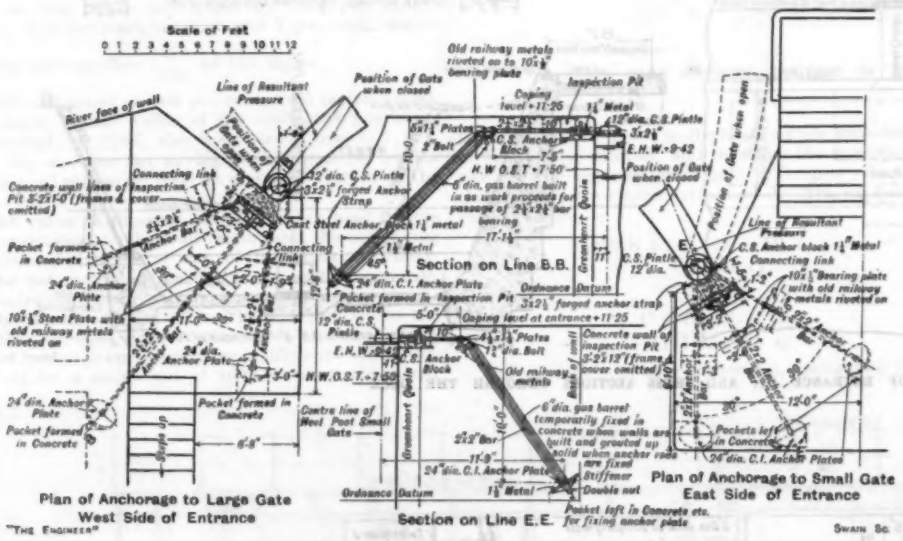


FIG. 5—ANCHORAGES TO LARGE AND SMALL GATES

The Foundry Trades Exhibition.

No. I.

THE Foundry Trades Exhibition, which was opened yesterday, the 15th, in the large Bingley Hall, Birmingham, and will remain open until the 24th inst., is the first of its kind to be organised in this country, and is, we believe, the first foundry exhibition ever held in Europe. The Birmingham branch of the Institution of British Foundrymen is to be congratulated on its enterprise in launching the project and in securing the co-operation of the Birmingham Chamber of Commerce and the British Cast Iron Research Association, while it is fortunate that the Bingley Hall, which is in the centre of the city, is available for the exhibition during the time when the Institution is holding its annual meeting and conference in the nearby Chamber of Commerce. The full title of the show is the International Foundry Trades Exhibition, but it is noteworthy that there are few exhibits from abroad. The stands, however, represent well the British firms connected with or interested in the foundry business. We commence below a description of some of the exhibits.

Crossley Brothers, Limited, Openshaw, Manchester, are exhibiting a gas-making plant which is supplying the apparatus on the adjacent stand of the Cast Iron Research Committee. The gas generator is of the open-hearth type, and has a capacity of 5000 cubic feet per hour. The gas, which is made with anthracite and has a calorific value of from 130 to 140 B.Th.U. per cubic foot, is passed through a scrubber and purifier, and is then mixed with air in the proper proportions for combustion by the Docking mixer shown in Fig. 1, which raises the pressure to about 80in. water gauge. The gas then goes on to the furnaces which are equipped with variable orifice burners having multiple nipples. The gas made by these generators is said to be as clean as that drawn from town's mains, while it can be produced at a much lower cost and will develop temperatures in the furnace ranging from 200 deg. to 1500 deg. Cent. Figures provided by the makers show that the gas costs 5½d. per 1000 cubic feet, with anthracite at 60s. per ton, and after making allowance for depreciation of the plant at the rate of 10 per cent. per annum.

Alldays and Onions Pneumatic Engineering Company, Great Western Works, Birmingham, have a cupola—as that shown in Fig. 2—as the principal exhibit. This cupola is capable of melting from 1 to 2 tons of metal per hour, is fitted with spark arrester and drop bottom, and has a hand-operated hoist. The cupola shell is built of mild steel plates riveted together with lap joints, and care has been taken in strengthening the bottom ring, charge hole and fettling hole. A hinged steel door is fitted to the charge hole, while the fettling hole is provided with a loose mild steel door, having a cross bar and fittings. The air belt is fitted with the usual elbow pipes and wing valves for the blast. Opposite each tuyere a mica sight hole and a door are provided. The tuyeres are bolted to the inside of the shell, so as to exclude the possibility of blast leakage between the lining and the shell. The cupola is carried on heavy cast iron pillars, and the fan used to operate it has a cast iron volute casing with all the joints machined. The fan runner is of the multi-blade type, constructed of sheet steel and balanced on a ground mild steel shaft running on ball bearings carried in dust-proof housings and lubrication by grease cups. A Roots blower, which can be used alternatively for supplying the blast required by the cupola, is constructed of cast iron. The flanges, revolvers, &c., are all machined and the gear wheels machine cut from solid blanks. The cast iron covers in which these gears are encased

FIG. 1—THE DOCKING GAS MIXER]

form an oil bath. The bearings are in the form of heavy gun-metal sleeves of the cone type, with an adjusting nut for taking up wear. The sand mill shown is strongly made of cast iron, fitted with a self-delivering fixed pan, and is actuated through gearing underneath the pan. The bearings are of generous proportions. The steel shaking or tumbling barrel exhibited is intended for cleaning light castings, and is constructed in ⅜in. steel plates, welded. It is provided with open and close lid and fasteners, and trunnions, and is mounted upon cast iron A standards. A sand mixer and disintegrator is included in the plant shown. This machine is suitable for mixing sand or for breaking or mixing slag, coal, coke, &c. It has an adjustable reel, which can be regulated with very little trouble to give any desired fineness to the sand or other material which is being ground or mixed. The adjustment is carried out without it being necessary to dismantle the machine or substitute other reels. Roller bearings are employed throughout. The material is fed into the hopper and immediately caught by the first revolving cage, which has the effect of breaking it up and scattering it among the other revolving cages. Each cage through which the material must pass is fitted with spindles of a closer pitch than those of the previous one, so that by the time it reaches the last cage it is reduced to the finest powder. The casing which encloses the revolving cages is of steel plate.

Tilghman's Patent Sand Blast Company, Limited, of Broadheath, is showing several pieces of apparatus on the stand of its Birmingham representatives

R. J. Richardson and Sons. Among these there is the sand blast tumbling barrel shown in Fig. 4, which has a barrel 30in. in diameter by 18in. long. It is intended for cleaning all kinds of small castings, up

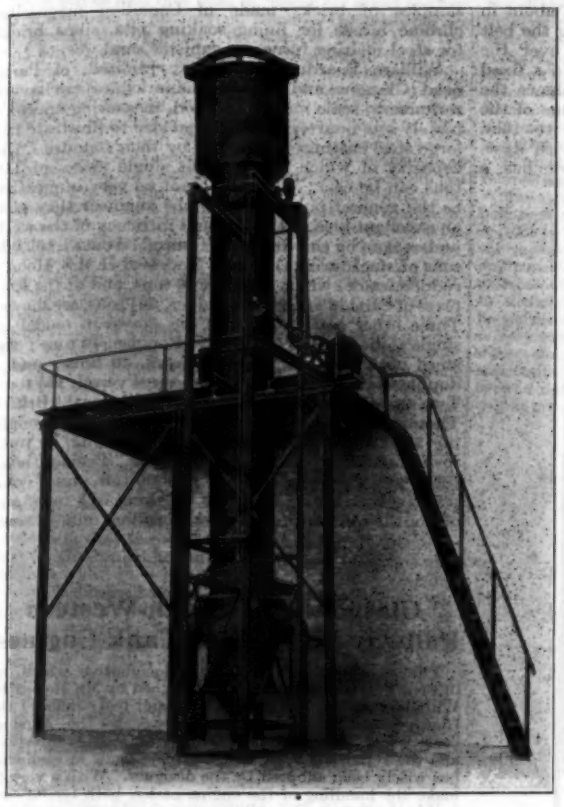


FIG. 2—ALLDAYS AND ONIONS CUPOLA

is provided with a sand and air mixing chamber, a cyclone sand and dust separator and an air sieving attachment. The abrasive used is either ordinary sand or chilled iron or steel grit or shot. There is

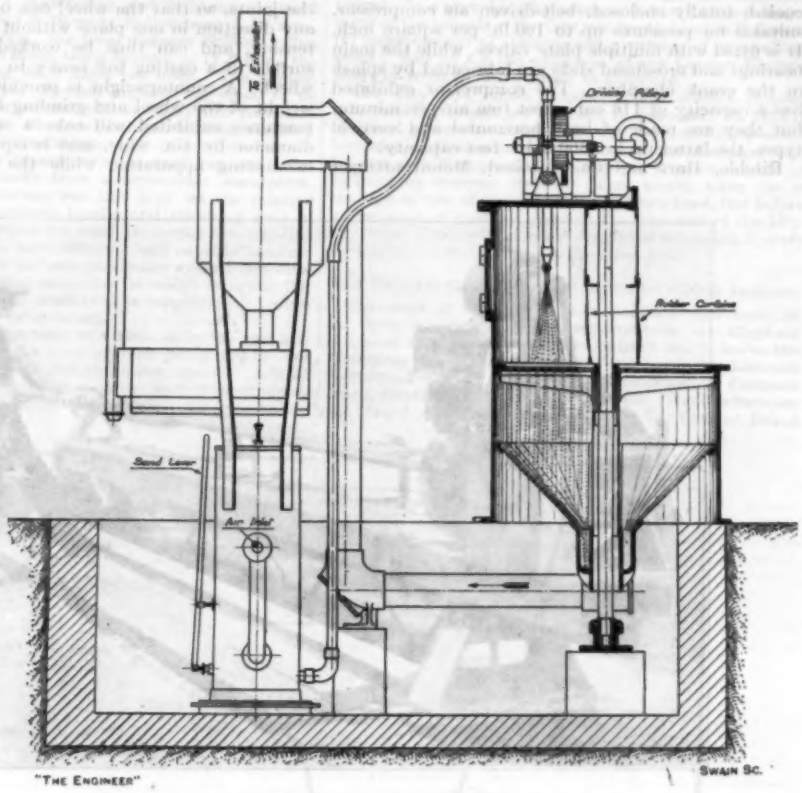


FIG. 3—TILGHMAN ROTARY-TABLE SAND-BLAST APPARATUS

to, say, 56 lb. weight each. The blast is directed through one or both ends of the cylinder, which is slowly rotated, causing the castings to tumble over one another, thus bringing all the faces of the castings

also a sand blast cabinet for cleaning small castings of every type, in which the operator stands in front with his arms through the openings directing the nozzle and watching the operation through a window.

dusty air is removed from the chamber by exhaustion, the abrasive material falling back into the mixing chamber below ready for re-use. The rotary table sand blast apparatus, shown in Fig. 3, is used for

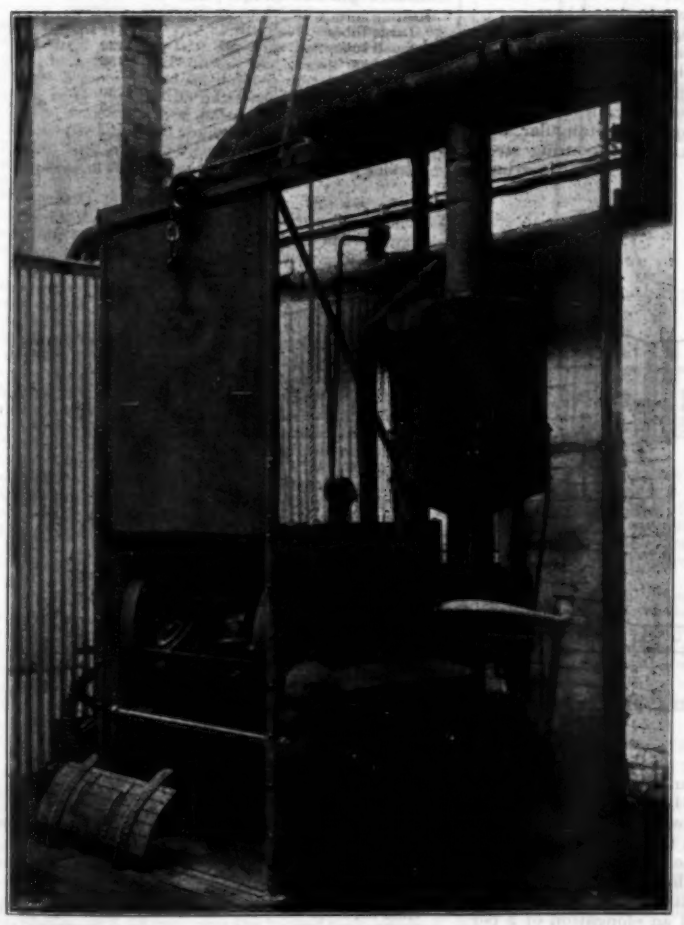


FIG. 4—TILGHMAN SAND-BLAST TUMBLING-BARREL

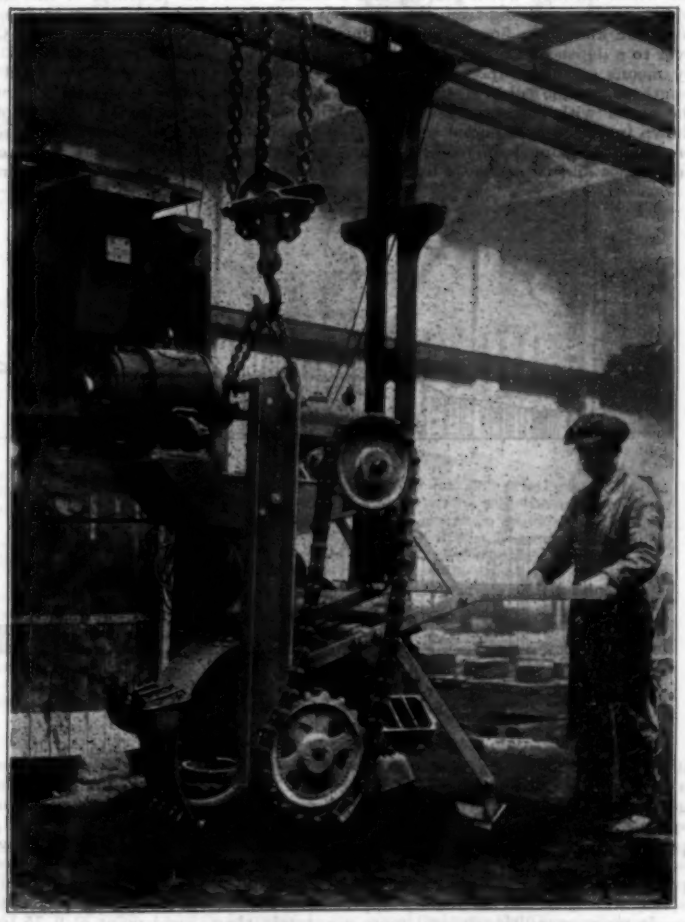


FIG. 5—RITCHIE-HART FOUNDRY FLOOR DRESSER

under the action of the blast. The operation of cleaning takes from 15 to 20 minutes. The sand blast apparatus used in connection with this barrel

The jet or nozzle may be fixed in a vertical or horizontal position or otherwise, as may be found most desirable. The cabinet shown is 3ft. square. The

cleaning medium-size castings. The jet or jets are arranged in the closed portion of the chamber and made to oscilate. Rubber curtains in front of the closed portion of the table are provided to prevent

the escape of the abrasive, dust, &c. The front portion of the table can be covered if desired during the operation. The apparatus used with this table

is the same as used with the tumbling barrel, being provided with a cyclone sand and dust separating chamber and air sieve. The return of the abrasive for re-use is provided for by aspiration, which also deals with the dust and spent air. The same firm is also showing a horizontal, double-acting, water-cooled, totally enclosed, belt-driven air compressor, suitable for pressures up to 100 lb. per square inch. It is fitted with multiple plate valves, while the main bearings and crosshead slide are lubricated by splash in the crank chamber. The compressor exhibited has a capacity of 116 cubic feet free air per minute, but they are made of both horizontal and vertical types, the latter up to 3000 cubic feet capacity.

Ritchie, Hart and Co., Limited, Mountpottinger Foundry, Belfast, are exhibiting the two special machines shown in Figs. 5 and 6. That illustrated by Fig. 5 is intended for digging over the foundry floor, at the end of a day's work, and preparing it for the next shift. It comprises a wheel fitted with buckets like those of a dredger and mounted in a substantial frame. A 3½ horse-power motor drives the wheel through worm gearing and a chain. The whole machine is hung from the foundry crane and is moved about the floor, which it thoroughly turns over to a depth of 12in., and at the same time levels by means of the scraper bar seen at the back. A length of flexible cable is, of course, used to supply the motor with current. The core-making machine shown in Fig. 6 is intended to obviate the laborious process of making loam cores on barrels supported on trestles and turned over by hand. It comprises,

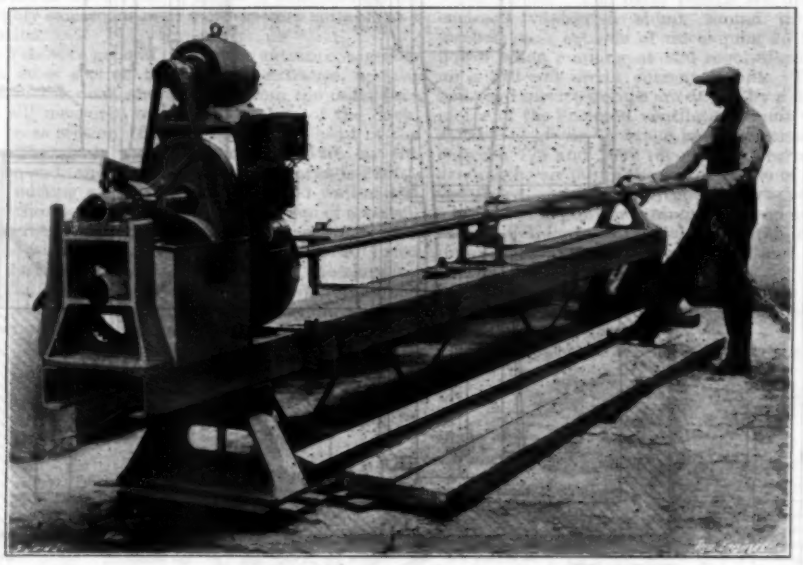


FIG. 6—RITCHIE-HART CORE-MAKING MACHINE

it will be seen, a back geared headstock, driven from a 1 horse-power motor through belt and friction gearing. The gearing provides for four separate speeds. A self-centring chuck is used to grip the pipe on which the core is built up, while the other end is carried by a movable poppet. A board is provided along the back of the bed for trueing up the cores, which, it will be readily appreciated, can be made more expeditiously and more accurately than is possible with the old-fashioned methods.

A. W. Sainsbury, Limited, of Campo-lane, Sheffield, is exhibiting a couple of swing-frame grinding machines, at work driven off overhead countershafts. This type of grinder, which is very popular in America and Canada, has been adopted quite extensively in the steel foundries of this country, but it is rather remarkable, in view of its undoubted handiness, that more of them are not used in our ironfoundries. The grinding wheel is mounted at the end of a double-jointed frame swung from overhead. A driving rope or Whittle belt runs over pulleys at each of the joints, so that the wheel can be moved about in any direction in one plane without affecting the belt tension, and can thus be worked about over the surface of a casting too heavy to lift up to a fixed wheel. A counterweight is provided to balance the weight of the wheel and grinding head. One of the machines exhibited will take a wheel up to 16in. diameter by 4in. wide, and is equipped with dust-exhausting apparatus, while the other set has a 9in. by 1in. on an overhung spindle, so that it may be easily taken off and replaced by a scratch brush.

Samuelson and Co., Limited, Britannia Works, Banbury, have, on the stand of their local representatives, R. J. Richardson and Sons, a collection of foundry machinery, such as Roots Acme blowers, plate moulding machines, smiths' hearths, &c., but the products of this firm are too well known for it to be necessary to describe them in detail here.

George Green and Co., Keighley, are also represented on this stand by means of an emergency cupola, with Y-shaped blast pipes, and a belt-driven fan on cast iron columns, for melting approximately at the rate of 20 cwt. of iron per hour; a rotary core machine, for making round, square, rectangular and oval cores; a 2-ton capacity bottom-pouring steel ladle, fitted with worm and worm wheel gearing, together with stopper gear; besides various sizes of single and double hand shank ladles.

The Magnesium Company, 34A, Buckingham Palace-road, London, S.W. 1, is showing a number of light alloys containing magnesium in various proportions from 2 up to 98 per cent. One, in which only a small amount of magnesium is alloyed with aluminium, is said to have an ultimate strength of 13.5 tons, a yield point of 9.75 tons, and an elongation of 3 per cent., with a specific gravity of 2.8. While other alloys have tensile strengths, as cast, up to 12 tons, with specific gravities between 1.8 and 2.0. Various finished parts, such as pistons, stampings and forgings, are shown to demonstrate the qualities of the alloys.

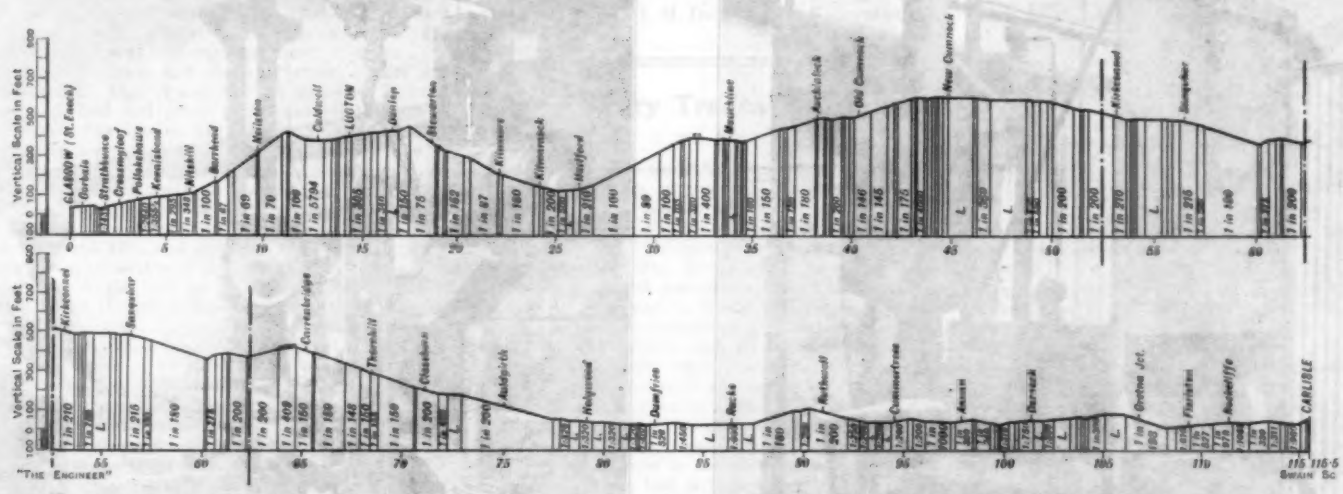
The General Refractories Company, of Kelham Island Firebrick Works, Sheffield, has a collection of high-class refractory materials, such as the Yorkshire sand for steel foundries, which was introduced during the war, when foreign moulding sand was unobtainable, and has, we believe, almost entirely superseded the foreign material. There are also samples of bricks made of Canadian magnesite, chrome bricks for lining soaking pits, silica bricks for steel melting furnaces, ganister sand, &c.

William Beardmore and Co., Limited, of Parkhead (Glasgow) and Mossend (Lanarkshire) are having recourse to scale models in wood, measuring approximately one-quarter of the actual size to illustrate the large steel castings turned out by their foundries, the capacity of which is such that single pieces of 110 tons can be cast. These may not be very impressive to the general public, but to the engineer they give an excellent idea of the size and intricacy of the work undertaken by this firm, which supplied over 1,100,000 tons of steel during the war. Models of H.M.S. Hood's rudder frame, which weighed 50 tons, and of the Empress of Canada's complete rudder, 50½ tons, are shown. Three other marine castings are shown in model—a single shaft bracket for H.M.S. Repulse, 40 tons; the stern post for a single-screw vessel, 20 tons; and a double shaft bracket for a twin-screw vessel, 15½ tons. Two models are staged of castings made for the British Thomson-Houston Company, one a fly-wheel weighing 31½ tons, the other a "spider" casting, 19 tons, for the armature of the same machine. Besides these, there are the crosshead for a 6000-ton press, comparatively small in size, but weighing 51½ tons, and one of the roll housings for a steel rolling mill, 42 tons.

Glasgow and South-Western Railway Baltic Type Tank Engines.

THE exceptionally large tank locomotive which we illustrate on page 668 has been designed by Mr. Robert H. Whitelegg to deal with the heavy and fast traffic of the Glasgow and South-Western Railway to the Ayrshire coast. The engines are intended to run in either direction, and the "Baltic" type, which gives a bogie at each end, has wisely been adopted by the designer. With a view to make the handling of the engine easier, both for forward and backward running, all the operating levers—regulator, vacuum brake, whistle and sand gear—are provided with duplicate handles on each side of the footplate, so that the driver can always stand on his right side. The following table gives the principal dimensions:—

Cylinders	22in. dia. by 26in. stroke
Coupled wheels, diameter	6ft.
Bogie wheels, diameter	3ft. 6in.
Wheel base, rigid	13ft. 2in.
Wheel base, total	39ft.
Boiler, outside diameter and front	5ft. $6^{9}/_{16}$in.
Boiler, length between tube plates	15ft. 4in.
Heating surface—	
Large tubes	442 sq. ft.
Small tubes	1132 ,,
Fire-box	156 ,,
Total evaporative	1730 ,,
Superheater elements	255 ,,
Total surface	1985 ,,
Grate area	30 sq. ft.
Working pressure	180 lb. per sq. in.



PROFILE OF THE GLASGOW AND SOUTH-WESTERN CO.'S LINE BETWEEN GLASGOW (ST. ENOCH) AND CARLISLE

Tractive effort in lb., at 85 per cent. boiler pressure	26,741
Water in tanks	2400 gallons
Coal	3½ tons

The weights of the locomotive are distributed as follows:

Leading bogie	21 tons 0 cwt.
Leading wheels	18 tons
Driving wheels	18 tons
Trailing wheels	18 tons
Hind bogie	23 tons 15 cwt. 2 qr.
Total	99 tons 1 cwt. 2 qr.

Six of these engines have been built by the North British Locomotive Company, and although they have only been at work a few weeks, they have, we are told, thoroughly justified their introduction and proved their capacity. We hope, in the course of a few weeks, to give

drawings and further particulars, but we present now a report of a test run made on one of these locomotives on a return trip between Glasgow and Carlisle, a total running distance of 231 miles. The train was composed of passenger coaches of the standard corridor type.

On looking at the profile diagram of gradients of the line, it will be seen that from St. Enoch for about the first 18 miles—that is, just beyond Dunlop—the gradients are all against the up trains, the steepest being 1 in 100, 1 in 67, 1 in 69, and 1 in 70, the total length of adverse gradients being about 15 miles of the distance. After leaving the summit, the line falls through Kilmarnock to near Hurlford, a distance of about 7½ miles, but at Hurlford begins the long 19¼ miles climb to New Cumnock, 45.4 miles from St. Enoch. The whole of this distance is uphill, with the single exception of a short drop between the 32nd and 34th mile posts, and the steepest gradients are 1 in 100, 1 in 99, 1 in 105, 1 in 160, 1 in 150, and 1 in 200. From New Cumnock the line falls all the way to Dumfries, a distance of 38 miles, with the exception of a short level piece about the 47th and 48th mile posts, and a short rise of 1 in 200 about the 63rd and 64th mile posts. The chief falling gradients in this 38-mile section are 1 in 360, 1 in 200, 1 in 180, 1 in 150, and 1 in 148. On the section Dumfries to Carlisle, 33 miles, the line is quite easy, with the exception of a short rise in both directions near Ruthwell. From Dumfries to New Cumnock the gradients are against the down trains, and the total length of the rising gradients equals 21 miles of the 38 miles in this section. From the summit the line falls for the next 20 miles through Hurlford to near Kilmarnock, and rises again to Dunlop, 7½ miles, the steepest gradients being 1 in 200, 1 in 180, 1 in 87, and 1 in 75, for a total length of 6 miles. After leaving Dunlop the gradients are all falling, until a mile from Shilford cabin, 1 in 100 rising, thereafter to St. Enoch, about 11½ miles, they are all down hill and in favour of down trains.

The train was timed to leave St. Enoch at 11 a.m., the total weight behind the engine being 310 tons, and the engine provided to work the train was No. 544. Starting at time, Kennishead was passed in 8.2 min., and Barrhead, 7½ miles from St. Enoch, in 12 min., an average speed of 37½ miles per hour. Lugton was reached in 24½ min. and Dunlop in 27½ min. from the start, or 15¼ min. for a distance of 9 miles, representing an average speed of 35 miles per hour on this section, with rising gradients of 1 in 100, 1 in 67, 1 in 69, and 1 in 70. From Dunlop to Kilmarnock, all down hill, the average speed was 53.7 miles per hour, the 7¾ miles being covered in 8.66 min., and Kilmarnock was reached in 36.16 min., including a signal check at Bonnyton cabin about ¼ mile from Kilmarnock Station.

After taking water, Kilmarnock was left at 11-42¼, with a load of 340 tons behind the engine. Hurlford, about 2 miles from Kilmarnock, was passed in 3.82 min.; Mauchline in 16.21 min.; and New Cumnock in 30¼ min., an average speed of 40 miles per hour, with rising gradients of 1 in 100, 1 in 99, 1 in 105, &c. From New Cumnock to Carronbridge, a distance of 19¼ miles, took 21 min., and to Holywood, about 14 miles, took 13¼ min., equal to an average speed of 55.7 and 62.2 miles per hour for the respective distances. From Holywood to Dumfries, 3.4 miles, took 4.82 min., including signal checks at Cairn Valley Junction, the average speed being 45.3 miles per hour, arriving at Dumfries at 12.52 p.m., where the engine again took water, and the load was further augmented till it amounted to 440 tons behind the engine. Starting at 1-2¾ p.m., Ruthwell was passed in 13.1 min. for the 8.5 miles, speed 39 miles per hour, and Annan, 7 miles, in 7¼ min., 57.93 miles per hour. From Annan to Gretna Junction, 8.86 miles, took 9¾ min., equal to 57.4 miles per hour, and from Gretna Junction to Carlisle, 8.7 miles, took 11 min., including slows for stopping, an average of 47.45 miles per hour for the last section of this journey.

The booked journey time—that is, the overall time between St. Enoch and Carlisle—was 166 min., and the actual time taken was 165 min. The time allowed for the Kilmarnock and Dumfries stops was 19 min.—Kilmarnock 11, Dumfries 8—but the time actually taken at these stations was 16.84 min., so that in actual running time 1.16 min. was lost in the through journey.

The return trip from Carlisle, with a commencing load of 440 tons behind the engine, proved just as interesting as the outward journey. Starting at 3-49, Gretna Junction was passed in 12¼ min., and Gretna Junction to Annan took 11.7 min., giving an average speed of 44.1 miles per hour for the 17.6 miles between Carlisle and Annan; to Ruthwell, 7 miles, took 7.6 min., and Dumfries, 8.48 miles, 9.45 min., the total distance between Carlisle and Dumfries taking 41¼ min. for the 33 miles, the average speed being 47.7 miles per hour for the section, arriving at Dumfries at 4-30¼. At Dumfries the engine took water, and train left at 4-38.1. The load leaving this station, for the long climb of 38 miles to New Cumnock, was reduced to 325 tons, and Holywood, 3.4 miles, was passed at 4-44.41, or 6¼ min. from starting. Auldgirth was passed in 5 min., and thence to Closeburn took 4.83 min., or an average speed for the first 10.46 miles of 39.2 miles per hour on rising gradients. Closeburn to Thornhill, 2.47 miles, took 3¾ min., and Carronbridge, 3.32 miles, was passed in 5.07 min. A signal stop at Ardoch was responsible for 6¾ min., and Sanquhar, 8¾ miles from Carronbridge, was reached in 17.3 min., including the time lost at Ardoch, or 10.8 min. for 8.6 miles, equal to an average speed for the distance of 47.7 miles per hour. From Sanquhar to Kirkconnel, 3¾ miles, took 4.83 min., and the next 7¼ miles to New Cumnock took 8 min., giving an average speed for the latter distance of 56¼ miles per hour. From New Cumnock to within ¼ mile of Kilmarnock the gradients are almost all falling and in favour of down trains. The distance from New Cumnock to Kilmarnock is 21.3 miles, and excluding 3¼ min. stop at Hurlford No. 2 cabin for signals, took 24.6 min., the average speed being 51.91 miles per hour.

The actual running time from Dumfries to Kilmarnock was 73.08 min., or 2.08 min. over the booked time, which, considering the stops at Ardoch and Hurlford No. 2 cabin when the train was travelling at speeds of 54 and 60 miles miles per hour respectively, shows remarkably good work with this heavy load, and it is quite reasonable to suggest that, had these stops not occurred, the running time would have been as many minutes under as over the booked time. The average speed from Dumfries to Kilmarnock was 47.75 miles per hour. Arrived Kilmarnock at 6-1 p.m., water was taken and load increased to 360 tons.

Leaving Kilmarnock at 6-11 p.m., Dunlop, 7.66 miles, took 15½ min., and the 5.4 miles to Shilford cabin took 7.6 min., equivalent to average speeds of 29 and 42.9 miles per hour respectively. From Shilford cabin to St. Enoch the gradients are all falling, and Neilston was passed in 1¾ min., Barrhead 2.16 min., Pollokshaws 3.85 min., and St. Enoch 7½ min., the total distance Shilford cabin to St. Enoch, 11.25 miles, being covered in 13.9 min., the average speed being 48.5 miles per hour. The highest speed attained on the outward journey was equal to 69 miles per hour, between the 20th and 21st mile post, and on the return journey 69 miles per hour, between the 86th and 87th mile post from Carlisle.

Throughout, this experimental or trial run was most interesting, particularly from a locomotive standpoint. While strict observation was not kept on the relative positions of the regulator handle and reversing gear in respect to the contour of the road, the enginemen handled the locomotive in a most efficient and capable manner, and considering they had not previously worked this class of locomotive over the main line, it would be quite fair to deduce that, with another like opportunity, much better results would be obtained.

Very careful measurement was made as to the coal and water consumption, the coal average being 60½ lb. per train mile, or 166 lb. per 1000 ton-miles, equal to .166 lb. per ton-mile. With experience on the part of the firemen, this figure is being steadily reduced. The water consumption on the up journey between Kilmarnock and Dumfries equalled 26.77 gallons per train mile, and on the return journey on same section 33.17 gallons per train mile, the difference being accounted for by the longer uphill journey, equalling 15½ miles more between Dumfries and New Cumnock than between Kilmarnock and New Cumnock.

One of the principal objects in making these trial runs was to ascertain to what extent the use of a more powerful type of locomotive on these important Scotch expresses would eliminate the use of a pilot engine, and the following schedule of loads permitted at present for one engine over the several portions of the line will serve to demonstrate how far the new locomotive has been successful in this respect.

Schedule of Engine Loads, Glasgow and Carlisle and Vice Versâ.

	Tons.
Glasgow to Kilmarnock	325
Kilmarnock to Dumfries	255
Dumfries to Carlisle	335
Carlisle to Dumfries	335
Dumfries to Kilmarnock	240
Kilmarnock to Glasgow	270

These latest engines on the Glasgow and South-Western Railway rank as the first of the type in Scotland, and about the most powerful tank locomotives in Great Britain.

THE production of coal in Czecho-Slovakia in 1921 is returned at 11,648,000 tons, the number of pits at work having been 372, employing 75,893 workers. The 233 lignite mines, which employed 51,440 men, produced 21,050,712 tons.

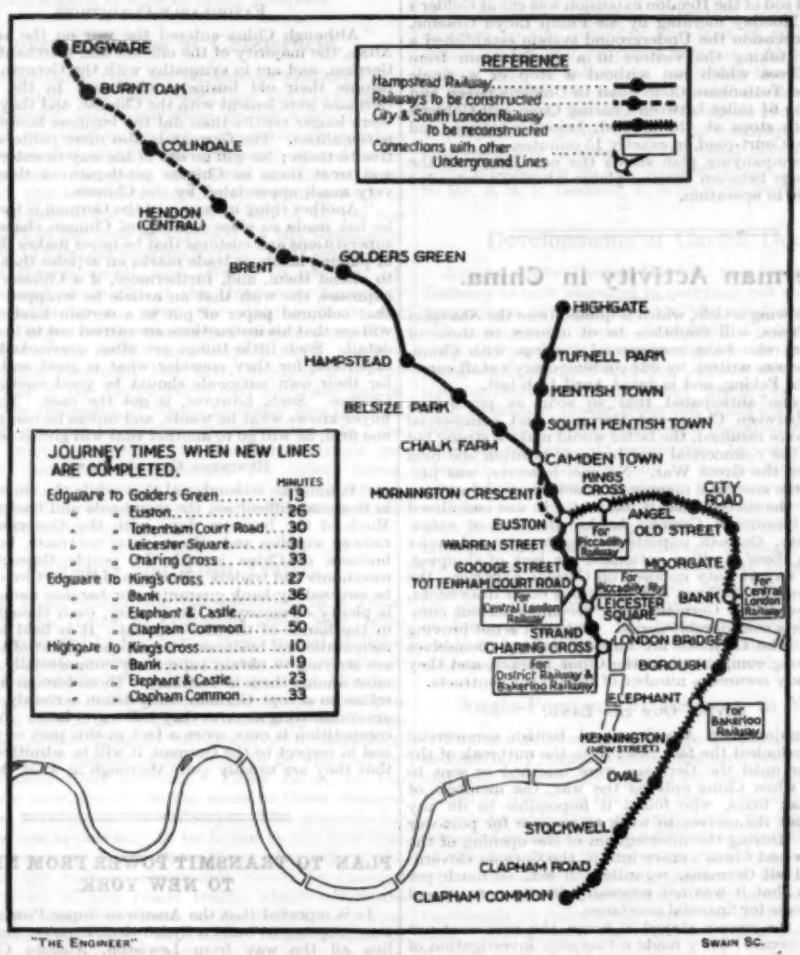
London Underground Improvements

THE Treasury guarantee to the London Underground Railways, under the Trades Facilities Act, is five million pounds, for a period of fifty years, and is (*a*) for the enlargement of the tunnels of the City and South London Railway; (*b*) improvement of stations and provision of new rolling stock; and (*c*) for the extension of the London Electric Railway from Golder's Green to Edgware.

The City and South London was London's pioneer tube, and its tunnels are 10ft. 6in. in diameter. In 1913 it obtained powers to extend the railway from its present terminus at Euston to a junction with the Charing Cross, Euston and Hampstead Railway at a point south of Mornington-crescent station. This would allow for a through service of trains between the two lines, but before interchange of traffic is possible the diameter of the City and South London tunnels will have to be increased. Powers for this also were obtained in the same Act.

THE RECONSTRUCTION OF THE CITY AND SOUTH LONDON.

The work of enlarging the tunnels has now been let in three contracts. The reconstruction at Clapham Common and Clapham-road is Contract No. 1, let to the Metropolitan Tunnel and Public Works Company, Limited. Between South Island-place and Stockwell is Contract No. 2, awarded to Messrs. Perry and Co. The line between the Angel and Euston will be done by Charles Brand and Son, under Contract No. 3. The work includes the lengthening of the platforms and the re-building of many stations. Escalators are to be provided at Clapham Common, Stockwell, the Oval, the Elephant and Castle, the Bank, and at Moorgate. It is roughly estimated that 30,000 tons of clay will have to be removed. The Borough station is to be closed from August 8th until further notice, in order to provide accommodation for the contractors. On the same date the line north of Moorgate will be closed until the tunnels thence to the terminus have been enlarged and the connection made with the Charing Cross line near Camden Town. Whilst this section is closed there will be a service of motor omnibuses between Moorgate and Euston, which will call only outside the intervening stations—Old-street, City-road, the Angel and King's Cross. We would add that the greater part of the City and South London Railway has been equipped with automatic signalling within the last couple of years.



MAP SHOWING LONDON TUBE RAILWAY EXTENSIONS

THE Euston-Camden Town Connecting Line.

The Euston-Camden Town connecting line is, we learn from the company's annual report, to be 1 mile 8 chains in length. There are already four tracks at Camden Town—the two Golder's Green and the two Highgate lines—so that the extension from Euston means six lines in all. As it is proposed to run trains between the City and South London and the Golder's Green and Highgate branches, the extension will require to be connected with both those lines. It is proposed to have a time-table giving a one-minute service in each direction through the junction, or 120 trains per hour. The lay-out of the junctions and the signalling are receiving special study. There will be no crossing of lines on the level; all will be done by flying and burrowing junctions. The contract for this work has

been let to John Mowlem and Co. It includes the temporary shafts, service headings, alterations to existing tunnels, and the junction and cross-over tunnels between Mornington-crescent and Camden Town stations. It is hoped that the line will be opened by October 1st, 1923, and that the enlargement of the City and South London tunnels will be finished by then also.

GOLDER'S GREEN TO HENDON NEW RAILWAY.

The line from Golder's Green to Hendon is 1.63 miles in length. It is a continuation of the existing Golder's Green railway, and has an intermediate station at Brent. The contract has been let to Messrs. Charles Brand and Son, who are doing the work between the Angel and Euston. It includes two new stations, a viaduct 30ft. high over the river Brent, retaining walls and embankments, and it is hoped that this also will be completed fifteen months hence. The station at Hendon will adjoin the aerodrome, which will be brought within 25 minutes of Charing Cross.

HENDON AND EDGWARE RAILWAY.

The extension from Hendon (Central) to Edgware will be 3.05 miles in length, and will make the distance between Edgware and Clapham Common one of 16.44 miles. There will be two intermediate stations—Colindale, 1.31 miles from Hendon, and Burnt Oak, 2.21 miles from Hendon. The line runs under the Midland Railway at the former station, and under the Great Northern as it approaches Edgware. The contract for the line has not yet been let, but it is hoped to finish construction by the end of 1923.

The first sod of the Hendon extension was cut at Golder's Green on Monday morning by Sir Philip Lloyd Graeme, on which occasion the Underground system established a record by taking the visitors in a special train from Charing Cross which ran without a stop or a single check from Tottenham Court-road to Golder's Green and covered the 6¼ miles between Charing Cross and Golder's Green, with stops at the Strand, Leicester-square, and Tottenham Court-road, in exactly 15 minutes.

The accompanying plan shows the new lines and the train timings between various places when the extended services are in operation.

German Activity in China.

THE following article, which is quoted from the *Shanghai Sunday Times*, will doubtless be of interest to those of our readers who have commercial dealings with China. The article was written by our contemporary's staff correspondent in Peking, and is dated April 11th last.

"Everyone anticipated that so soon as peace was declared between China and Germany and commercial relations were resumed, the latter would make a strong bid to regain the commercial and business position she held previous to the Great War. No one, however, was prepared for the energetic manner in which the task has been tackled or the success that it has met. It was considered that the closure of German banks, the loss of extra-territoriality, German imports having to pay a heavier duty than those of allied nationals, the lack of shipping, the heavy export duty imposed on German exporters, the limited banking facilities and numerous other drawbacks, would prevent the Germans from becoming serious competitors for a considerable period. But such is not proving the case. The Germans are already making themselves felt as strong competitors in the China market, and they have already secured a number of important contracts.

SPYING OUT THE LAND.

"The majority of American and British commercial houses overlooked the fact that, from the outbreak of the Great War until the Germans were interned or sent to Germany when China entered the war, the members of the German firms, who found it impossible to do any business, set themselves to work to prepare for post-war activities. During the interregnum of the opening of the Great War and China's entry into it, the German Government paid all Germans, regardless of sex, so much per month, so that it was not necessary for them to appeal to the Chinese for financial assistance.

"While the women stayed at home, the men went out into the interior. They made a thorough investigation of the requirements of the Chinese in the various provinces, and, as most of them spoke Chinese fluently, they gained considerable first-hand information, even going so far as to book orders to be delivered so many months after the war had finished. It is doubtful to-day if there is any other nationality so well informed as to Chinese requirements, methods of transit and Chinese business in general as are the Germans. It was not until the war had been in progress for some years that the American Government decided that it was necessary for trade conditions in China to be closely studied, and even then the majority of the men sent out had no knowledge of the country or its language. It is true that the consuls at the various treaty ports sent in excellent reports of the business conditions in the districts in which they were situated, but they were nothing to be compared to the statistics and data the Germans secured.

SOME OF THE CONTRACTS.

"The fact that they are at the moment in a position to give quick shipments has already secured them a considerable amount of business. In Shanghai, one of Germany's largest electrical concerns has made arrangements to erect a large electrical manufacturing plant. Through the failure of the Banque Industrielle, the bank which had the contract for the building of the Peking Tramways, they have, through a Chinese concern, secured the building of this important tramway system. In Mukden, Manchuria, they have, through a Danish firm—Messrs. Nielsen and Co.—secured a contract from Marshal Chang Tsolin, for the building of a large arsenal, which will be able to turn out artillery. At the same time they secured a large order for textile and other machinery, amounting to a considerable amount of money. When these contracts were secured, the business firms of other nationalities in China were greatly surprised, and they were also greatly surprised when they saw by the Customs returns that every month the German imports were growing in volume.

"It is foolish to undervalue the importance of German competition in this country, yet to a great extent this is being done. Germany's best business men are being sent out here, and these, in conjunction with the German business men who have worked many years in China and know the conditions, are a commercial and business force to be reckoned with.

HERR STINNES' PLANS.

"I am told that Germany's great organiser, Herr Stinnes, has his agents in every important port and city in China and Siberia, and that when the reports have been sent to the headquarters in Germany it is the intention of a gigantic combine of manufacturers and exporters to concentrate their efforts on securing a firm hold on the China market. It must here be pointed out that it is necessary for American and British manufacturers and exporters to take this competition seriously. The cheapness of German labour in comparison with that in other European countries and America, the determined effort the German people are making again to place their country on a sound economic and industrial basis, and the large stocks of manufactured goods of certain descriptions which they have already on hand awaiting the purchaser, are all factors tending toward success. Their knowledge of the country and language, their painstaking care and attention to detail, and their willingness to work long hours, even under the climatic conditions prevailing here, are also in their favour.

FAVOURABLE CONDITIONS.

"Although China entered the war on the side of the Allies, the majority of the officials and merchants are pro-German, and are in sympathy with the German efforts to resume their old business relations. In the past, the Germans were lenient with the Chinese, and they also gave them longer credits than did the business houses of other nationalities. The German is also more polite and attentive to them; he will go out of his way to entertain them and treat them as Chinese gentlemen—a thing that is very much appreciated by the Chinese.

"Another thing in favour of the German is the fact that he has made so close a study of Chinese characteristics, superstitions and customs that he never makes the mistake of putting labels or trade marks on articles that are likely to offend them, and, furthermore, if a Chinese merchant expresses the wish that an article be wrapped in this or that coloured paper or put in a certain kind of box, he will see that his instructions are carried out to the minutest detail. Such little things are often overlooked by other exporters, for they consider what is good and sufficient for their own nationals should be good enough for the Chinese. Such, however, is not the case. The Chinese buyer knows what he wants, and unless he can get it from one firm, he will go to another that will give it to him.

BUSINESS CAN BE DONE.

"It must be remembered that while the Government is in financial difficulties, the merchants and traders are not. Much of the business done with the Government is in railway supplies and other similar contracts, but the real business of China is with the people through Chinese merchants and traders. Business of this nature can always be covered by bank guarantees or bargain money. There is plenty of money in the country, even though it is not in the hands of the Government. It is held by Chinese mercantile and business communities. Most of the nations are striving to obtain supremacy commercially, and foremost among them is Germany. Those foreign firms which refuse to accept German competition seriously, I believe, are committing an error they will regret later. For German competition is once more a fact in this part of the world, and in respect to the German, it will be admitted, I think, that they are usually quite thorough in what they do."

PLAN TO TRANSMIT POWER FROM NIAGARA TO NEW YORK.

IT is reported that the American Super-Power Corporation proposes to build a hydro-electric power transmission line all the way from Lewiston, Niagara County, to Yonkers, N.Y., where connection would be made with the local lines supplying New York City. The estimated cost of this line is 27,457,000 dols., and the Power Corporation promises to supply, not only the base load for the electric companies distributing power in New York City, but also to supply communities in the south, central and south-eastern parts of New York State where power is not now available. The proposed transmission line will consist of four circuits, each capable of carrying 75,000 kilowatts, at 220,000 volts, three-phase electric current, at sixty cycles. These circuits will be carried on two independent power lines on a right of way 350ft. wide.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE MACHINE—SLAVE OR TYRANT?

SIR,—The people of Samuel Butler's "Erewhon" banished machinery from their realm in dread of the time when machines would develop the power of propagating themselves and assume mastery over the human population. But what was a nightmare to the Erewhonians fifty years ago is now a vision of delight to the mass production engineer. To devise a turret lathe, say, that would automatically produce other turret lathes which would in their turn breed turret lathes—this is indeed the shining summit of the engineer's ambition. And he is rapidly pressing onwards and upwards; already groups of machine tools will semi-automatically reproduce themselves. Is he, then, according to Butler's theory, falling more and more under the influence of the monsters he has created? The engineer himself would scorn the suggestion; so far from his creations growing more tyrannous, daily they become more docile and more responsive to his slightest gesture. Yesterday a clumsy belt-shipping lever started a lathe; to-day, pressure on a button controls it; to-morrow, perhaps, someone will come along with a phonographic device by which the machine will answer to its master's voice.

This confidence in the ability of man to keep his slaves, the machines, permanently in subjection is far from being wholly shared by the engineer's unprofessional brethren. Some of them bluntly say that already, in our hearts if not in our deeds, we rank machines higher than men. They point out that infinitely more concentrated thought is lavished on the creation of a machine tool than on the operator who ministers to it, and that the cost of the tool exceeds the amount spent on the man during his whole life. It is more important nowadays to make machinery comfortable than to make people comfortable. Passengers on ocean liners may find themselves stowed away with far less regard for their feelings than are the engines of a light cruiser. If 40,000 horse-power can be packed into a space hardly bigger than a bedroom, then quite obviously the only reason why first-class travellers are even to-day herded together in three-berth cabins is simply because nobody has taken the trouble to think of something better. Our critics are well aware of the countless hours that Dr. Taylor and his associates have spent trying to find how to cut metal properly and what is the correct height for a vice; where is the experimenter, they say, who has determined the ideal shape for a soup spoon, or the relative position of table and chair that will enable the diner to use his knife and fork most conveniently? Surely spoons and forks are used more than files and lathe roughing tools.

There may not be very much here to support the theory of the tyranny of the machine, but there is enough, so prejudiced people would say, to convict engineers of an unhealthy preoccupation in just those things that happen to interest them, to the exclusion of everything else. We are likened to the man who, discovering how useful fire is for cooking and baking things, would insist on lighting a fire in the middle of every room, regardless of the disfigurement of the walls and the suffocation of the occupants. Hence our Forth Bridges and our Assuan Dams evoke only moderated transports, while our Hunslets and Brightsides and Wolverhamptons receive unstinted condemnation.

Let us not, because of their threadbare familiarity, contemptuously ignore these complaints, and still more, let us not lose patience with the complainants. They need our sympathy. They miss much of the joy of life. Not for them is the pure æsthetic delight of studying the proportions of Mr. Gresley's new locomotives; they know not the thrill of designing a boring fixture that reduces an operation time from two and a-half hours to thirty-three minutes. Besides, it is the engineer himself who is responsible for the increased apprehension about the future that is now manifesting itself. Has he not spread, or allowed to be spread, tales of the marvellous new powers that are almost within his grasp? Is his record as guardian of the energy of steam and electricity sufficiently reassuring to mark him out as a fit and proper person to undertake the control of the vastly greater, if somewhat hypothetical, powers of atomic energy? Before we release such a very formidable Djinn from the bottle we want to make quite sure that the Djinn will know his master.

The engineer's reply will be clear and brief. In his own hands his mechanisms always have been and always will be obedient slaves; only under the lax and unfamiliar control of the lay world does the machine make any display of undisciplined strength. For his sins in the past in too lightly yielding up his inventions to an immature world the engineer may be duly penitent; in future he must cultivate a more exalted sense of his authority, entrusting nothing new to mankind until men show that they are educated to the point of wisely using their gifts. But increased responsibility must be balanced by increased humility. No arbitrary limit must be accepted to the field within which the engineer's talent for compactly disposing matter may be exercised. When he has brought his pumps and turbines momentarily to perfection, he must not despise such lowly tasks as improving the kitchen cooking stove, designing a garden gate that will not squeak, or perfecting a door knob that will not work loose.

A. H.

June 13th.

COUPLING ROD DRIVES.

SIR,—In your issue of yesterday you illustrate on page 654 a set of side coupling rods at 90 deg. Can, and will, you kindly suggest where any patentable matter is embodied in this arrangement, which I have, with many other locomotive engineers, used for many years?

What is the matter with our Patent Office passing such well-known things as patents in these days? Are they hard up for fees, or is it for want of well-known engineering knowledge?

The theory is as old as the hills, and I am surprised at you publishing same without some qualifying remarks perhaps too difficult to find.

WILLIAM P. DURTHALL, M.I. Loco. E.

Glasgow, June 10th.

[Coupling rods are set at right angles to prevent any chance of "jamming" by the two rods falling on the line of centres simultaneously. In this patent the arrangement is adopted to reduce vibration. An old device may be patented in connection with a new purpose, but in this case the point is an exceptionally delicate one. If we commented on all the patents that are granted without any apparent reason, our time would be well filled.—ED. THE E.]

THE British Non-Ferrous Metals Research Association has just issued, in its Quarterly Bulletin, a list of those periodicals of interest for reference on industrial metallurgy. The service provided by fourteen libraries in London, Birmingham, and Manchester is clearly indicated, so far as concerns the one hundred and eighteen periodicals which have been selected. Since one of the main functions of the Industrial Research Associations is to serve as distributing centres for scientific and technical information to their members, such a key-index should prove of great value and will doubtless be followed by other bodies for their own special subjects. It may also be taken as an indication of the interest that is likely to be taken in the proposed World List of Scientific Periodicals of the Conjoint Board of Scientific Societies.

A Seven-Day Journal.

Manganese Ore in the Highlands.

SOME time ago it was announced that a discovery of manganese had been made at Dalroy, near Culloden Moor Station on the Highland Railway. With a view to determining whether the surface indications had anything behind them, a shaft was sunk. At a depth of 25ft. a seam of manganese ore, 7ft. in thickness, was encountered lying over a deposit of hematite from 4ft. to 7ft. thick. Samples of the manganese ore showed it to contain 45 to 65 per cent. of the metal, so that the quality has been proved to be high grade. Efforts are now being made to determine the extent of the deposit. It is confidently hoped that the discovery will lead to the commercial development of the deposit. Manganese ore, it should be noted, is found widely distributed in many parts of Scotland. It is, for instance, known to occur in the Leadhills and in the islands of Arran, Mull, Skye, Orkney and Shetland.

An Iron and Steel Combination.

A PROVISIONAL arrangement for the combination of their interests has been arrived at between the directors of Bolckow, Vaughan and Co., Limited, and Redpath, Brown and Co., Limited. The first-named firm was established in 1864 and has an authorised capital of £5,000,000. It manufactures iron and steel at Middlesbrough, and owns several collieries, iron mines and quarries. Redpath, Brown and Co., Limited, were established in 1896, and have an authorised capital of £600,000. They carry on business as iron and steel merchants and constructional engineers, with works at East Greenwich, Glasgow, Manchester, and elsewhere.

A World Power Conference.

A WORLD Power Conference, to be held in London in 1924, is now being organised by the British Electrical and Allied Manufacturers' Association, with Mr. D. N. Dunlop as director. The Conference will concern itself with actual and potential sources of industrial power, and will, in particular, discuss the world's mineral fuel resources, hydro-electric power, irrigation and transportation, the improvement of technical education and other cognate subjects. It is anticipated that the Conference will result in the compilation of an inventory of the world's power resources, the acceleration of mechanical progress and an improved means of exchanging information relating to scientific invention and discovery.

Larger Wagons for British Railways.

IN the course of a recent interview, Sir Robert Hadfield urged the adoption of larger goods wagons in this country as a means of helping to reduce the present burden on industry imposed by the high railway freights. In the United States, he said, freight cars, with a tare weight of 20 tons, and carrying 46 tons of goods, were extensively used, while in this country our wagons barely accommodated a sixth of that load. Quoting Sir Henry Thornton, the general manager of the Great Eastern Railway, he remarked that wagons up to 30 or even 40 tons capacity could be advantageously employed on British railways.

The Late Mr. James Bain.

THE death has to be recorded of Mr. James Bain, superintending engineer for more than thirty years of the Cunard Steamship Company. Mr. Bain was born in 1841, and was a son of an engineer who had worked under Sir Robert Napier. He himself served his apprenticeship under Sir Robert at the famous yard on the Clyde. After his training on shore he proceeded to sea as an engineer in the Cunard Line, and subsequently in the White Star Line. In 1876 he was appointed a surveyor for Lloyds, and ten years later he rejoined the Cunard Line in the capacity of superintending engineer, a post which he continued to hold until he retired a few years ago from active work. During the course of his service with the Cunard Company, he witnessed and assisted in many marine engineering developments. His first duty as superintending engineer consisted of preparing the Etruria for her maiden voyage to America. From that time onward he was intimately associated with all the developments in the way of improved propulsive machinery which are historically associated with the vessels of the Cunard Line.

Proposed New Railway for London.

THE Eastern Railway Group, comprising the Great Northern, Great Central and Great Eastern railways, is understood to be considering the question of constructing a new railway about 20 miles in length, running east and west in the north of the London area. The line would start at or near Denham, on the joint line of the Great Western and Great Central companies, and skirting Watford, Elstree, Chipping Barnet, and many other towns and villages, would connect with the Great Northern main line near Wood Green and with the Great Eastern at Palace Gates. The construction of this line would enable trains to proceed from the north to the south of England without touching at any of the London termini or main junctions, and would also enable the three companies of the Eastern Group to distribute their traffic to the best advantage between King's Cross, Marylebone and Liverpool-street. Incidentally, it would afford a direct route between many important points on the outskirts of London, and provide a connection with the Great Western Railway. Proposals to construct a similar "outer circle" railway for London have been made on several occasions in the past, but have invariably come to nothing, largely because of disagreement among the companies concerned in them. As this new proposal connects the lines of three railways co-operating in a group, it would seem, so far as this cause is concerned, to stand quite a good chance of being accepted.

Coke Oven Gas at Chesterfield.

FOR some time past the Grassmoor Colliery Company, Limited, has been supplying the Corporation of Chesterfield with coke oven gas at a fixed price of 1s. 6d. per 1000 cubic feet. On being approached for an increased supply, the company offered to let the Corporation have the additional amount required at 1s. 3d. per 1000 cubic feet, with a sliding scale of 2d. per thousand for every rise or fall of 1s. per ton in the cost of gas coal as supplied by the Grassmoor Company to local gas-making works. The Corporation declined this proposal, and offered to pay 1s. 1d. per thousand or 1s. 2d. if the Grassmoor Company would undertake to meet the sinking fund and interest charges on the mains and meters connecting the coke ovens with the Corporation's holders. Considerable comment has been aroused over the matter, for if the Corporation can purchase gas at 1s. 3d. per thousand, it seems to many strange that it cannot sell gas to consumers at less than 4s., the present price. According to the Corporation's gas engineer, however, the charges for rates, taxes, distribution, &c., amount to 2s. 10d. per thousand, so that by selling the gas at 4s. the Corporation would actually be losing money.

Railways and Road Traffic.

AFTER being under the consideration of a Committee of the House of Commons since May 16th, the Bill promoted by the North-Western and Midland Railway Group, under which powers were sought to carry goods wholly by road, was dropped on Monday. The promoters decided that no other course was open to them in view of the sudden revelation by Sir George Beharrell, of the Ministry of Transport's considered opinion on the matter of the rates to be charged for the proposed road services. These rates, in the Ministry's view, should be the same as those charged for equal service on the railways. The grounds for this view are apparently to be found in the fear that if the rates were lower than those charged on the railways, the railway companies would be enabled to throw on to the roads traffic which otherwise they would strive to retain on the railways by providing increased traffic facilities. Thus, instead of the companies being compelled to widen or electrify their lines, they would pass the burden on to the authorities responsible for the provision and upkeep of the roads. As the scheme of the Bill with regard to rating had received the consent of a large body of traders, and as the promoters suddenly found themselves in opposition to the Ministry of Transport in connection with an important principle of the scheme, it was decided that no course was open to them except to withdraw the Bill in its entirety.

The Engineering Dispute Settled.

THE result of the second ballot of the members of the Amalgamated Engineering Union was announced on Tuesday, and revealed a two to one majority, very nearly, in favour of accepting the employers' terms. The number of votes cast in favour of acceptance was 75,478, while 39,423 were recorded against. In the January ballot, the result of which led directly to the lock-out, 35,525 votes were given in favour of acceptance and 50,240 against. Those taking part in the first ballot represented 22 per cent. of the members of the union. In the second ballot, 28 per cent. voted. The lock-out of the "Engineers" began on March 13th, and has thus been brought to an end after a period of exactly three months. The employers have gained their claim to the recognition of their rights to exercise managerial functions, as set forth in the memorandum originally rejected by the union, with certain modifications of comparatively minor importance. Otherwise the dispute has exercised a severely harmful and restrictive effect on the country's industrial position, just at a time when signs of returning prosperity were becoming visible. One union—the Boilermakers—still holds out against the acceptance of the employers' terms, but the Ironfounders, who, like the Boilermakers, recorded an adverse majority in the recent ballot of the forty-seven unions, have reversed their decision in a second ballot, and are now going back to work.

The Taxation of Motor Vehicles.

THE Departmental Committee of the Ministry of Transport studying the question of the taxation and regulation of road vehicles has decided to invite suggestions as to the best method of levying tax on mechanically propelled vehicles. From this source it is required to raise an annual revenue of about 10½ million pounds sterling, exclusive of the sums received by way of licences for horse-drawn vehicles, fees for drivers' licences and penalties for offences. It is important that any scheme submitted should be accompanied by a statement of the figures upon which it is based, and that these figures should be capable of verification. Special attention should also be devoted to the difficulty and cost of collecting the duties under any proposed scheme. At present the annual cost of collection, including the registration of vehicles and the issue of drivers' licences, is about £350,000. Any increase in this figure required under a proposed scheme should be compensated by a corresponding increase in the total annual revenue. Communications on this subject should be addressed to Mr. J. S. P. Godsell, 7, Whitehall-gardens, S.W. 1.

Developments at Cardiff Docks.

AT the Bute Docks, Cardiff, the Great Western Railway is now engaged in carrying out an extensive programme of improvements, the total cost of which will amount to about £250,000. Included in the proposed work is the modernisation of the hydraulic pumping equipment and the improvement of the coal-tipping facilities. At present the docks are served with hydraulic power from ten pumping stations, in none of which is the machinery installed regarded as being up to date. It is proposed to concentrate the plant in four stations, and to use turbine pumps in place of the existing engines. The four new stations will have a total horse-power of 5300, as compared with 5080 in the existing stations. In addition to the improvement in the hydraulic and tipping equipments, the programme includes the complete overhauling of the boiler plant at the Queen Alexandra Dock, and its equipment with mechanical stokers and other modern appliances. At present, these boilers are liable to be flooded at times of spring tide, and it is therefore intended to raise their level.

Anglo-Persian Oil Refinery in Wales.

THE new refinery of the Anglo-Persian Oil Company at Llandarcy, near Swansea, has now been completed, and will be formally opened by the President of the Board of Trade on the 29th inst. The undertaking is a very notable one, not only from its size—the site occupied extends to about 650 acres—but also because of the fact that it represents the first occasion on which an attempt on a commercial basis has been made to refine crude oil into its constituents several thousands of miles away from the source of production. The scheme has occupied three years of continuous work in its completion, and has involved the expenditure of some three million pounds. From the jetties pipe lines are laid to eight transit tanks, each holding 10,000 tons, which have been erected on an area adjoining the docks. Direct-coupled electrically driven centrifugal pumps are used to deliver the oil or refined products from or to these tanks to or from storage tanks situated at the refinery about four miles away. These storage tanks have a total capacity of 20,800,000 gallons. With this equipment a 10,000-ton tanker can be unloaded in about twelve hours, and can be loaded with refined products in twenty hours. Oil arriving at the dock one day can, it is stated, be returned as fuel oil from the refinery on the third. The refinery at present can deal with 15 million gallons of oil per month, but later on this figure will be considerably increased. The conditions attending the manufacture, packing and transport of the by-products provided the motive for establishing the refinery in this country rather than, as usual, in the country of origin of the oil.

Sheffield Steel Products.

SHEFFIELD Steel Products, Limited, has found it necessary to issue a denial of certain rumours, originating, it is understood, in Sheffield, to the effect that the whole of its works were to be closed down indefinitely. This rumour, the firm states, is totally untrue. In actual fact, the company is relatively well placed as regards orders, and in its cutlery and plate department is even working overtime. The general turnover is normal at the moment, and in the next few months is confidently expected to show a substantial improvement.

A Modern Flour Mill.

No. III.*

THE MILL.

THE mill building, as before mentioned, is in the same block as the wheat-cleaning department, but is divided from it by means of a rope race. The two departments are of the same height, and the only connections between them are by means of outside gangways, the fire insurance regulations preventing direct access from one department to the other. The machinery in the mill, as in the wheat-cleaning department, has been so arranged that elevating and conveying are reduced to the lowest possible limit. For that reason the various types of machines are placed together upon that floor which is most suitable for their particular position in the milling system—Fig. 21. One of the most striking features in the flour mill is the entire absence of free dust, and the cleanliness of the mill is a point which impresses itself at once upon the visitor. The flour manufactured in a modern mill is produced under ideal conditions.

The most important machines in the milling process are the roller mills, and they, in the Millennium Mills, are placed on three floors, viz., the basement, the whole of the first floor, and part of the third floor. The first floor has a most impressive appearance, having six lines of 40in. double roller mills with thirteen in each line—Fig. 22. Each roller mill weighs practically 3 tons, and is driven at a high speed, but the absence of vibration and noise on this floor speaks well for the design and construction of the machines.

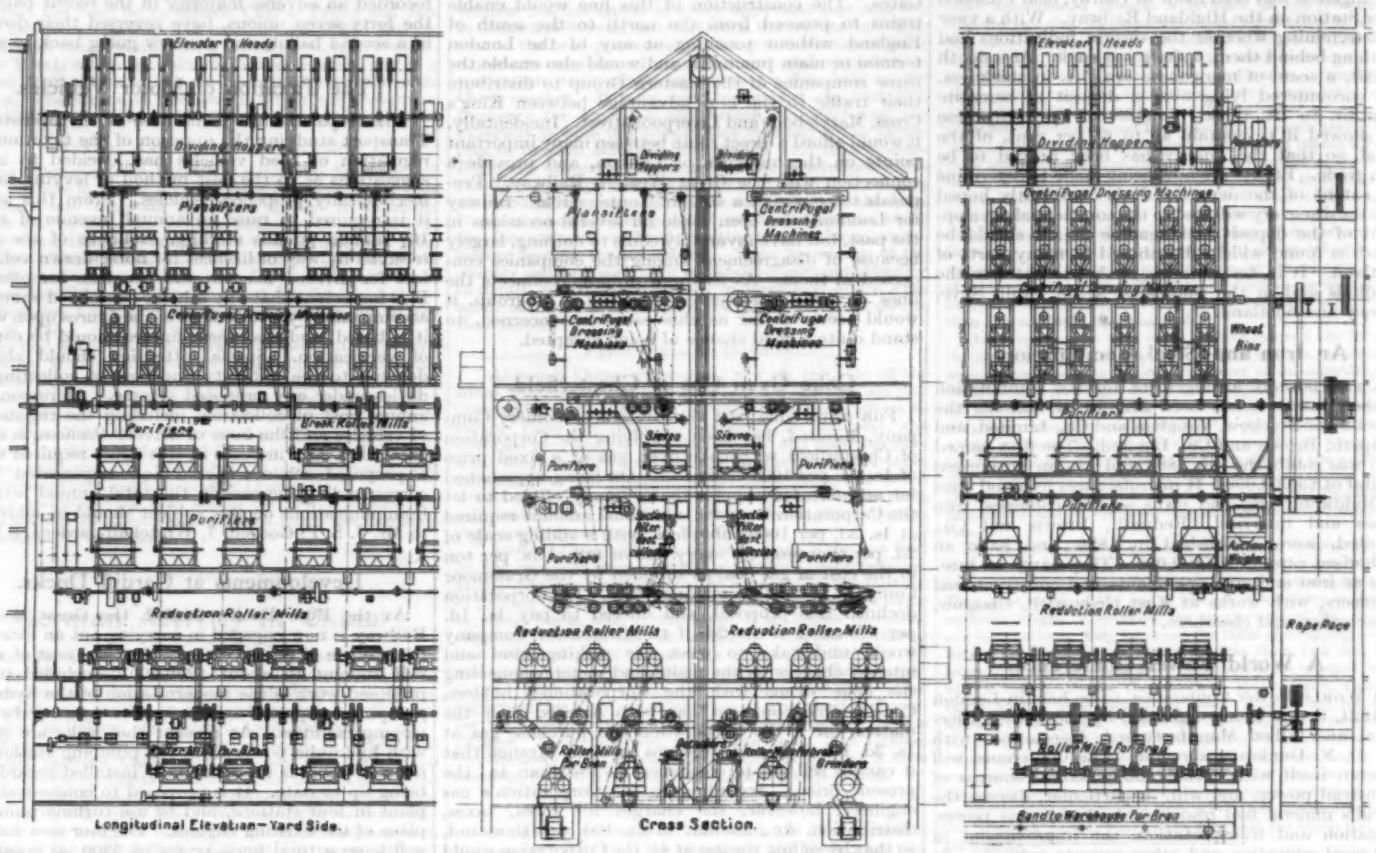


FIG. 21—PART SECTIONAL ELEVATIONS OF THE MILL BUILDING

As has been mentioned earlier, these roller mills are used first in the system for breaking down the wheat and releasing the internal portions of the wheat berry, and afterwards for reducing the portions released into flour. The roller mills form the most important link in the chain of operations in the manufacture of flour, for it is upon the success with which these machines perform their task that the yield and quality of finest white flour most of all depends. Each roller mill contains four rolls, that is to say, two pairs, each machine thus being really two distinct units working in one frame. The rolls themselves are made of the highest grade of chilled cast iron mounted on steel spindles forced in by hydraulic pressure, the rolls being accurately ground to less than one-thousandth part of an inch after the spindles have been inserted. The chill is sufficiently deep to admit of the rolls being re-ground and re-fluted many times. The frame of the roller mill is of massive box frame construction, and is provided with large doors which permit of a complete inspection of the work being made. In the design of these machines particular attention has been given to the feeding arrangement. It is of great importance that this feed should be spread evenly and in a very thin stream along the entire length of the roll, and in order to ensure this the top portion of the roller mill is arranged as a feed hopper fitted with revolving feed rolls and automatic gate the full length of the main grinding rolls—Fig. 24. The feed plate is hinged at the top and held against the feed roll by means of springs; the weight of the material behind the gate and the action of the roll pulls the feed out in a thin stream and throws it between the grinding rolls. Adjustments are provided for ensuring exact parallelism between the feed plate and the feed roll, as this is essential if the stock is to be spread evenly along the whole length of the grinding rolls; both horizontal and vertical adjustments are provided so as to allow for this. The grinding rolls themselves are also adjustable both as regards parallelism and distance from one another. This latter adjustment has to be extremely fine, and after the exact parallelism has been obtained by means of adjusting screws, the final setting for

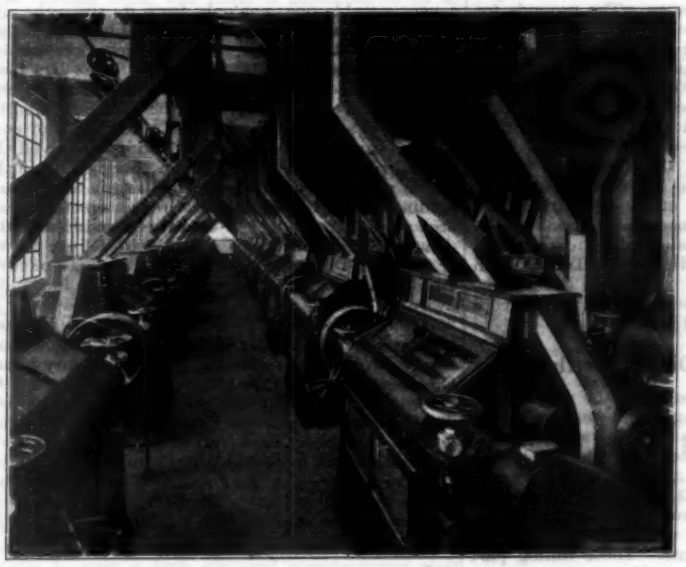


FIG. 22—PART OF MAIN ROLLER MILL FLOOR

FIG. 23—THE PLANSIFTER FLOOR

* No. II. appeared June 9th.

grinding is carried out by means of one single micrometer screw which controls the positions apart of the two rolls without interfering in any way with the parallelism.

Provision is also made on these machines for throwing the rolls apart should it be necessary at any time to stop the feed on any of the machines. This is accomplished by depressing a single lever, which, in addition to throwing the rolls apart, simultaneously stops the feed rolls and so holds back the feed. Replacing this lever in its original position starts

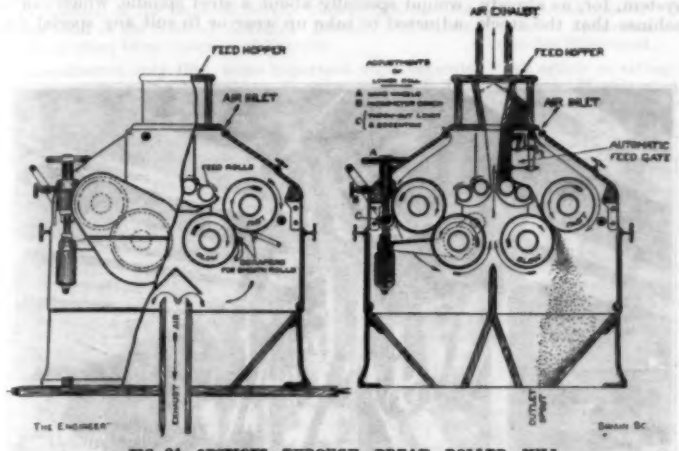


FIG. 24—SECTIONS THROUGH BREAK ROLLER MILL

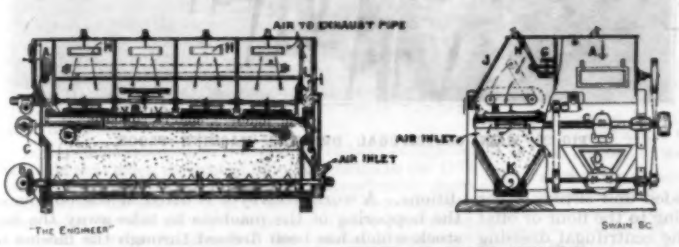


FIG. 25—SECTIONS THROUGH SIMONS' STANDARD PURIFIER

the roller mill grinding to exactly the same degree of fineness as before without any further adjustment being necessary. The gears are helical machine-cut, and run in an oil bath totally enclosed in dust-tight casings.

The break rolls are always fluted and have a maximum length of 60in. The reduction rolls, which are smooth, do not exceed 40in.; both sets of rolls are 10in. diameter. The top roll, which is the fast one, is driven direct through belt and pulley; the lower roll is driven from the top one by gears, so as to run slower, this differential speed producing a cutting instead of a crushing action. For break rolls the fast roll runs at 350 revolutions per minute, but for reduction rolls the fast roll only runs at 210 revolutions per minute.

The stock, after treatment on the break roller mills, is fed to a line of bucket elevators arranged along the whole length of the floor between the third and fourth lines of rolls, and is lifted to the top of the mill, where it passes through a series of dividing hoppers so as to split up the feed equally between the Simon free-swinging plansifters, of which there are twenty arranged in two lines—Fig. 23. These plansifters are used for the scalping of the break stocks, and from a mechanical point of view are of special interest. Each plansifter comprises two nests, each of twelve superimposed sieves, each about 3ft. by 5ft. The sieves have a rotary motion similar to that used with an ordinary hand riddle. The sieving surfaces are horizontal, and the rotary motion is in a horizontal plane. The desired movement of the material, both that which has passed through the sieves and that which tails over, is produced by the action of successive projecting impellers fitted along one side or the other—according to the direction of motion required—of each sieve channel—Fig. 26. Thus a nest of sieves can be arranged so that the "throughs" or "overtails" shall follow any scheme of flow from sieve to sieve. Any desired arrangement of parallel and series of flows can be arranged for, and either "throughs" or "overtails" can be taken off from any sieve.

Owing to the number of superimposed sieves the whole work of scalping the break stock, dressing out the break flour, and grading the semolina and middlings ready for sending on to the purifiers is carried out on the one machine in one continuous process. The sieves are clothed with either silk or wire according to their purpose in the system, and are kept clean by means of automatic brushes propelled across the sieves by the action of the machine. Two nests of sieves are mounted in a frame with a space between, in which is fixed a bearing carrying the crank pin of a vertical crank shaft.

The upper end of the shaft is supported in a bearing fixed to beams overhead, and carries a pulley driven by a quarter-twist belt from the line shaft. The weight of the machine is taken by four groups of flexible canes, which prevent the sieves from "revolving" round the shaft, but allow the swinging part of the machine to describe a small circle in plan, of the same diameter as the circle traced out by the crank pin.

At 180 deg. with this crank a weight—Fig. 27—is keyed excentrically to the shaft. This weight is fixed half above and half below the bearing, so as to avoid any "couple" in a vertical plane. The magnitude and excentricity of the weights are arranged so that the shaft remains vertical, and the sieves trace out a circle—in a horizontal plane—of the required size (about 3½in. diameter) to produce the sieving action. The shaft is free to swivel in both top and bottom bearings; thus there is no possibility of side strains on either the machine or the building due to "out of balance" stresses. These machines not merely maintain a balance when running, but are remarkably stable, and quickly settle down to their normal path even if deliberately pushed sideways.

Very little power is required to drive these machines. This will be understood when one considers that the motion of the machine is similar to that of causing a long freely supported pendulum to swing so that the lower end moves round in a small circle. For the same reason, not only is there a complete absence of vibration in the machine itself, but no vibration is transmitted to the building, as the centrifugal forces of the sieves and frame are exactly balanced by those of the balance weights. The balancing of these machines and the method of driving presented many difficulties in the past owing to the severe stresses that were liable to arise from "out of balance" forces. These troubles have now been overcome, and the plansifters seen in this mill run entirely without vibration.

On the second and third floors are arranged the purifiers—see Fig. 21—for separating the branny particles from the semolina, middlings, and dunst, made on the roller mills and prepared for this further treatment on the plansifters and centrifugals. Though the stock has been graded according to size, it still

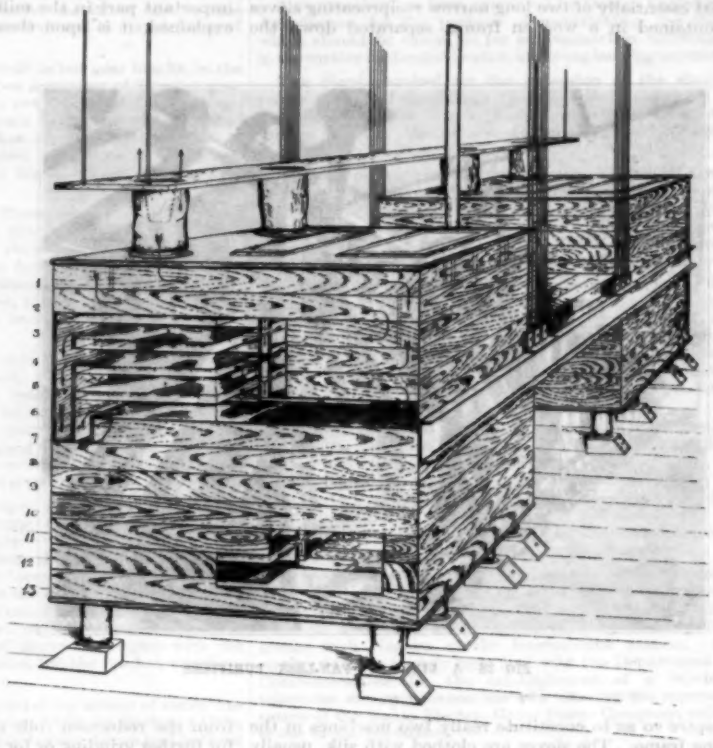


FIG. 26—PLANSIFTERS

contains a considerable quantity of light impurities mainly portions of the skin of the wheat. This bran is valuable for cattle foods, and is collected, graded, and rolled in machines set aside for that purpose, but it must be eliminated from the stock going to the reduction rolls if the finished flour is to be pure and a good colour. The purifier is an invaluable machine in that it enables a separation to be made which is quite impossible to obtain either by mere sieving or by mere aspiration. The purifier has a compound action. Air is drawn up through the material while it passes along the inclined sieve. By this means light,

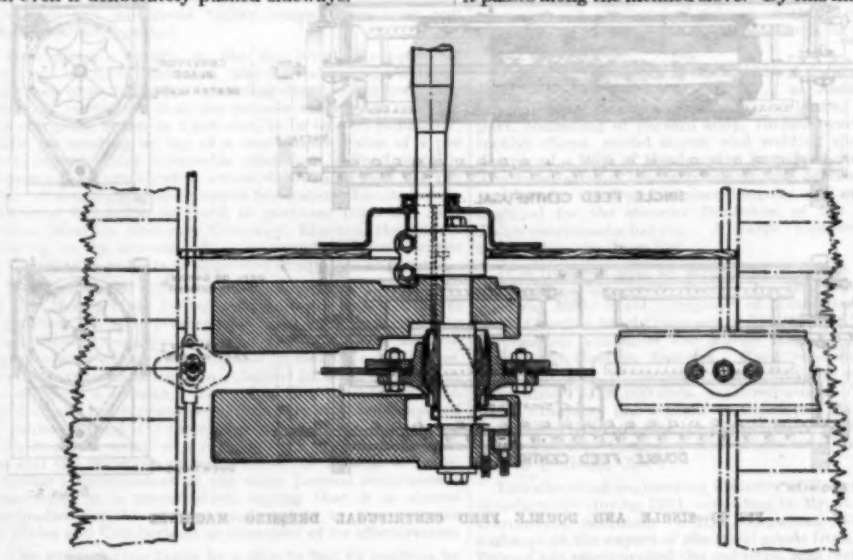


FIG. 27—PLANSIFTER MECHANISM

branny particles can be floated down the sieve and prevented from falling through the meshes even though they may actually be smaller than these meshes. Many improvements have been effected in the construction of purifiers in recent years, and change in design has been mainly directed towards the prevention of dust-laden air escaping into the mill. Fig. 25 shows Messrs. Simons' standard machine. In it, A represents the feed hopper; B the brush-cleaned tins over the sieve; C the excentric shaft; D the worm cross gear; E the side channel collecting

from the tins; F the sieve brush; G the longitudinal air trunk; H the air valve; J a glass inspection door; K the collecting worm; and L the tail aspiration. The machines seen in this mill are slightly different, being constructed to suit Messrs. Vernon's special requirements. The purifiers are aspirated by means of independent fans exhausting through textile filter dust collectors. A number of machines are linked up to one fan, yet the strength of the air currents on each individual machine, and even on a particular section of a machine, can be regulated to suit the work required in that particular unit. The purifiers consist essentially of two long narrow reciprocating sieves contained in a wooden frame, separated down the centre so as to constitute really two machines in the one frame. The sieves are clothed with silk, usually of four different meshes from the head to the tail of the sieve, the finer mesh silk being at the head end. Tin collecting trays or troughs are arranged immediately above the sieve across its full width, with small spaces between each trough to allow the air currents to pass through. The chamber above the tins is divided into four compartments, corresponding to the different silk meshes, and by an arrangement of valves, the air current on each section of the sieve can be regulated. The stock is fed on to the sieve by means of a feed roll, which distributes it evenly across the whole width of the silk. The air currents passing up through the silk lift out the light impurities, which are carried upwards by the air into the expansion chamber, where the heavier particles fall back and are caught in the tins, the very light particles being carried on into the air trunk, where they are automatically collected and delivered. The purified stock passing through the sieves is delivered by a worm conveyor to convenient outlets. The under side of the silk is swept by a travelling brush, which keeps the meshes clean and open. The material collected on the tins is automatically swept out by the travelling brushes into a side channel and carried by the reciprocating action of the machine to the tail end, where it is delivered to a spout and taken to the offal side of the mill. The purifier sieves are suspended by four hangers. These can be adjusted to increase or decrease the speed with which the stock travels down the sieve. Means are also provided for readily adjusting the distance between the tins and the silk in any particular compartment. A line of these machines is shown in Fig. 28.

The centrifugal dressing machines, the majority of which are used for dressing the stock for the reduction rolls, occupy the whole of the fourth floor—see Fig. 29—and part of the fifth, and are arranged two-high in order to economise space. There are more than 120 of these centrifugals, some double and some single, in Messrs. Vernon's mill. Centrifugals play an important part in the milling system, for, as already explained, it is upon these machines that the stock from the reduction rolls is graded and sifted, either for further grinding or for sending to the flour or offal sacks. The main feature of the centrifugal dressing machine, whether of the single or double-feed type, is its gentleness of action combined with maximum dressing surface, and for dealing with all classes of stock from the reduction rolls this machine works excellently. So satisfactory, in fact, has this machine proved for its particular duty for many years, that centrifugals, designed on well-defined lines, are installed by practically all the leading flour-milling engineers.

In the past the centrifugal was also very generally used for the scalping of all "break" stocks, but since the mechanical difficulties experienced with early plansifters have been overcome, those machines are now largely employed for that duty, but the centrifugal still maintains its superiority for treating "reduction" stock.

The machine—Fig. 30—consists of a polygonal reel covered with silk or wire contained in a wooden frame with hoppered bottom. Inside the reel are rapidly revolving beaters so designed as to lift the stock and direct it obliquely across the silk. These beaters comprise mild steel blades mounted on spiders fixed to the beater shaft which runs in ball bearings. These beaters extend the full length of the reel, and are notched at their outer edge to form fingers which are slightly twisted. The rate at which the stock is propelled across the silk cover can be varied according to requirements by altering the angle of the beaters. The reel itself, when used for dressing stock from the reduction rolls, is covered with silk, forming a very fine sieve. The silk varies in general practice from about eighty threads per lineal inch to about one hundred and twenty-five to the inch, and is specially woven for the purpose. This silk is prepared by a special process, and is so woven that the mesh is perfectly square and open, and is secured so that there is no danger of the threads shifting their position and so enlarging the mesh. A brush is fitted for keeping the meshes clean and open. This brush is wound specially about a steel spindle, which can be adjusted to take up wear or to suit any special conditions. A worm conveyor is fitted at the bottom of the hoppering of the machine to take away the fine stock which has been dressed through the meshes of the reel, and the blades of the conveyor can be adjusted to deliver to either end of the machine or at any convenient point or points. The beater shaft runs at 200 revolutions per minute, whilst the reel only makes 20.

FIG. 28—A LINE OF FAN-LESS PURIFIERS

FIG. 29—MAIN CENTRIFUGAL DRESSING MACHINE FLOOR

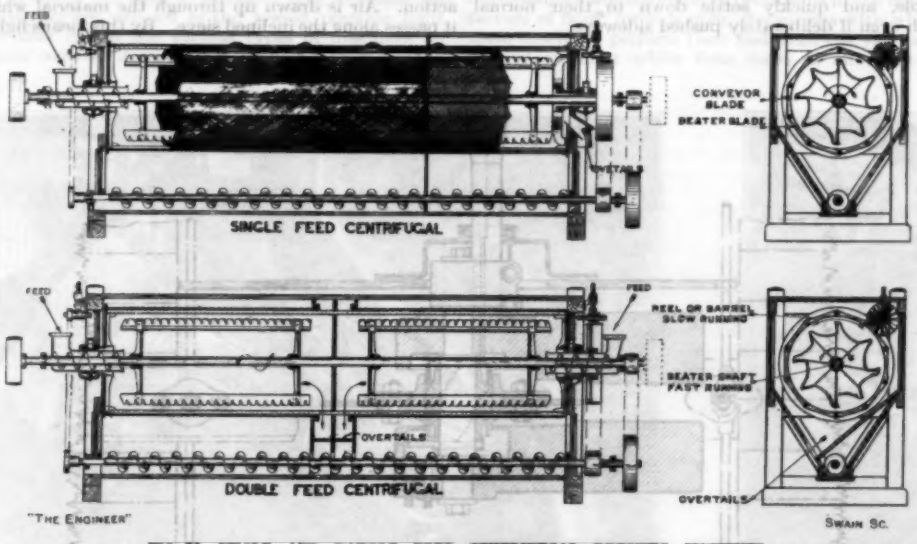


FIG. 30—SINGLE AND DOUBLE FEED CENTRIFUGAL DRESSING MACHINES

IMPROVEMENTS AT PORT TALBOT.

There are one or two interesting features in the wharves which are being constructed at Port Talbot for the requirements of the iron and steel and patent fuel industries established at the port.

In connection with the new patent fuel works, which will be among the largest in South Wales, now being erected for the Phœnix Patent Fuel Company, a reinforced concrete wharf, 600ft. long, is being built, and is now in an advanced state. Most of the piles are in position and preparations are being made for laying the decking. The scheme includes the provision of an overhead gantry for cranes for loading the product of the works on ship for export.

The other wharf, the details of which are not yet quite settled, has been designed by Mr. W. Cleaves, the engineer to the dock company, for the discharge of iron ore and other raw materials to the blast-furnaces which Baldwins, Limited, have recently put in operation, and for the loading of rails and other products of the associated steel works. The wharf will be 900ft. long, with a depth of water alongside of 32ft. It will carry three lines of railway on the lower deck at quay level, and will, like the patent fuel wharf, have an overhead gantry to carry heavy cranes and transporters. The design makes provision for locomotive loads of about 80 tons, and crane axle loads on the upper deck of from 30 to 35 tons, on spans varying from 15ft. to 38ft. A preliminary operation, in addition to the dredging, which has been completed, has been the diversion of the river Ffrwdwyllt, the course of which was adjacent to the blast-furnaces, into the docks through an open channel. The river now flows through a double concrete culvert for a length of 600ft. The culverts are about 12ft. wide with a minimum height of 4ft. 6in., and are deepened at the dock end to provide a reservoir for the pumping station, which delivers water to the works for cooling purposes.

An extension of the Port Talbot graving dock to make its dimensions correspond with the length of the entrance lock to the docks, 445ft., is also in progress. The work consists in the removal of the existing concrete dam, and the substitution of a steel sheet pile dam, triangular in plan and designed to facilitate removal in the event of a further extension of the dry dock being necessary in the future. That this may be the case is suggested by the fact that consideration may be given to a scheme for a large new entrance lock, 880ft. long and 90ft. wide, as well as to the extension of the existing South Breakwater for a length of 1000ft.

The directors of the Great Western Railway have, upon the recommendation of Mr. C. B. Collett, the chief mechanical engineer, decided to establish a research department at Swindon, and have appointed Mr. T. C. Davison, lately the company's chief assistant chemist and analyst, to take charge.

Railway Matters.

THE London and North-Western Company is running many of its heavy long-distance trains with Lancashire and Yorkshire engines. They are, however, provided with North-Western tenders, as they carry more coal and water.

AN error crept in the notice in this column a week ago of the Birthday Honours. It is Sir William Acworth who has been made a Knight Commander of the Star of India. We ought also to mention that Mr. Stanley G. Spencer, of the Public Safety and General Purposes Department of the Ministry of Transport, has been made a Companion of the Imperial Service Order. Mr. Spencer is the head of the Railway Accidents Branch, and to him we have often been under an obligation.

COMMENCING July 10th, some important improvements will be made in the East Coast Scottish services. The 3.40 p.m. from Aberdeen will arrive in Edinburgh in time to connect with the 7.25 express to the South, due King's Cross 6 a.m. The Aberdeen-Penzance and the Edinburgh-Southampton services will have Glasgow connections. The 4 p.m. Glasgow—Edinburgh 5.15 p.m.—dining car express to Leeds will be re-timed on the North-Eastern system so that the 44 miles 10 chains between Darlington and York will be covered in 43 min.

SPEAKING on the 2nd instant at a meeting of the London, Chatham and Dover shareholders, held for the purpose of sanctioning the terms of the South-Eastern and Chatham electrification scheme, the chairman, referring to the question of amalgamation between the South-Eastern Railway and the Chatham and Dover Railway, said that the present position was that the two companies had come to terms, and it was only a question of a few weeks at the outside when a circular would be issued. The amalgamation of these two companies before they came to deal with the Brighton and South-Western Companies was essential.

ACCORDING to *Modern Transport*, an effort is to be made to revive some portions of the Outer London Railway. Bills for such a line came before Parliament in 1906, 1911, 1913, and 1914. The earlier schemes were killed by the opposition of the northern railway companies, and the last attempt was thrown out on second reading because it was likely to be an eyesore in some of the few remaining rural districts in Northern London. The present proposal is said to be for a line from the Great Western and Great Central Joint Line near Denham to Palace Gates on the Great Eastern, with junctions with the Great Northern main line near Wood Green.

IN a statement issued on behalf of the railway companies it is said that when the cost of living has fallen to the 1914 level, the annual wages bill will be considerably more than double the amount paid in that year. It would have been easier for the railway companies to have effected an all-round decrease in fares had the volume of passenger traffic remained at the 1920 figure. Comparing the second half of 1921 with the corresponding period of 1920 there was a decrease of 79 million passengers. It is estimated that if the fares are to be reduced to 50 per cent. over pre-war figures, it will require an increase of 98 million passengers to make up for the loss of revenue.

ANSWERING a question as to wireless communications on railways, Mr. Pease said lately, that permission was given in 1920 to the Midland Railway Company to establish wireless communication between certain points on its system and to the Marconi Company to conduct tests of such communication on the system of the London and North-Western Railway Company. The Marconi Company proposed last year to supplement the preliminary tests on the London and North-Western Railway by a more extended trial, and it was then offered a licence for the purpose, but the proposal was not proceeded with. So far as he was aware, Mr. Pease added, no experiment in wireless communication on railways had since been carried out.

THE London and North-Western Railway Company has copied the Great Western in establishing a suggestions scheme. A circular from Mr. Arthur Watson, the general manager, to the staff says: "It is further recognised that almost every railway employee has ideas concerning the management or working of his railway, but that there has existed a certain amount of diffidence, and, in some cases, difficulty, in making known those ideas to someone in authority. Suggestions from the staff on all matters likely to promote the economical working of the concern or to increase the receipts are, therefore, welcomed. Such matters are:—(*a*) Any new method—mechanical or electrical—which, it is believed, will result in economy; (*b*) the elimination of the waste of engine power, stores and materials; (*c*) improved methods of working trains or road vehicles and accelerating movement; (*d*) improvement in rolling stock and equipment; (*e*) improvements in passenger and goods station working; (*f*) improvements in stationery forms, office methods and equipment; (*g*) the prevention of accidents; (*h*) the improvement of relations with our customers and the securing of additional business to the company."

THE Turin correspondent of the *Economist* wrote, under date May 27th: The recent debate in the House of Deputies on the Railways Budget was terminated with a unanimous vote on the desirability of a better application of the principle of an eight-hour day for railwaymen. Many members spoke with alarm of the fact that railwaymen understood the eight-hours' principle as an obligation not to work, but to be present for eight hours, so that the effective hours of work are said to be only 2.6. The number of men employed on the State railways went up from 147,289 in 1913–14 to 206,600 in 1920–21, and the average annual cost from 2065 lire to 9700 lire. And this greatly increased number of men gives a less efficient service, as appears from the vastly increased cost of damages paid to shippers for delay, waste, thefts, &c. From 3.9 million lire in 1913–14 (1.13 per cent. on a total of goods carried of 347.4 million lire) the damages paid rose in 1920–21 to 97.8 million lire (3.64 per cent. on a total of goods carried of 2685.6 million lire). Public opinion, as the debate in the Chamber shows, is awakening to the danger, and the responsible Minister claims that in a year or two things will be once more normal.

Notes and Memoranda.

IN connection with the solar eclipse that is to take place next September, Mr. Massy Greene, the Federal Minister for Defence and for the Navy, states that a fully equipped wireless station will be set up at Wollal on the coast of West Australia, and that time signals will be established with Bordeaux, Adelaide and Washington.

THE second issue of the *Safety News and Chronicle* contains, among others, a very interesting article on the mine rescue work carried out at the front during the war, which should prove helpful in organising similar work in commercial mines. The relative merits of the various forms of apparatus are reviewed and a novel form of stretcher illustrated.

AN article on rolling the teeth in hot gear blanks, in the *American Machinist*, describes a process of forming gear wheels in which no metal is cut away and the teeth are formed by rotating a hot blank in contact with a toothed former. The operation takes about fifteen seconds to complete and the teeth are said to be stronger than those formed by cutting out of a blank, while their finish is equally good.

AN article, in *Stahl und Eisen*, on the Basset process of producing steel directly, discusses the possibilities of the scheme and professes to show that it is impracticable. The principal argument put forward is that in order to obtain the temperature necessary to melt the metal, the gases would have to be burnt, to carbon di-oxide, to such an extent that they would re-oxidise the spongy metal rather than reduce it.

A QUICK repair job on a large water main, described in the *Engineering News-Record*, was carried out in New York last month. A 36in. cast iron main, buried 5ft. under the street, burst and released a flood of 70,000,000 gallons per day. The break occurred during the afternoon of May 29th and the repair gang was quickly on the scene. Two pieces of the pipe were removed and replaced by new sections and the main put in service again on May 31st.

THE rising of the Mississippi flooded the waterworks pumping station at Vicksburg, and the water invaded the boiler-house, but the plant was kept going. As a precaution against a complete shut down a coal siding was raised 2ft., and a large locomotive was run in with a train of coal trucks before the flood reached its height. An extension was put on the funnel and the boiler connected with the pump-house steam range. An illustration in the *Engineering News-Record* shows the engine with the flood water well above the axles, but the fire-box was then, it is said, 2ft. out of water.

A PROCESS for seasoning timber by means of ozone has been developed at the Sorbonne, Paris, by Professor Otto, and is claimed to give results in twenty days equal to those obtained naturally in several years. The process consists simply in exposing the wood to a current of ozone-charged air. The colour remains unchanged, and microscopic examination is reported to have shown that ozone-dried oak and walnut had the same characteristics as ordinary air-seasoned wood. The experiment seems to have reached the commercial stage, as Italian and French companies are, it is said, arranging to work the process.

AN iron alloy which is very resistant to heat was recently described to the American Society for Steel Treating, by Mr. G. R. Brophy, of the General Electric Company. The principal constituents of the alloy are iron, aluminium and nickel. The melting point is 2777 deg. Fah., the specific gravity 7.03 and the tensile strength 36,800 lb. per square inch. Calite, the name given to the alloy cannot be machined in the cast condition, nor cut with oxy-acetylene. Any change of dimension or finish must be done by grinding. It is more resistant to oxidation at high temperatures and will stand higher temperatures than any base-metal alloy tested.

REMARKABLE results in the recovery of copper are claimed to have attended the operation in Western Australia of a process for extracting copper from low grade ores. It is claimed that the process will enable oxidised ore of a grade as low as 2 per cent. to be treated profitably, while by treating an ore of a recoverable value of 4 per cent. copper under favourable conditions, refined metallic copper can be produced at a cost of not more than £40 per ton. A company styled Copper Separation, Limited, is in course of formation in Perth to purchase from the Australian Minerals Recovery Company, Limited, the patent relating to the process. It is proposed to issue licences to operate the patents to approved companies or persons.

WRITING to the Editor of the *Builder*, Mr. A. P. Laurie, of the Heriot-Watt College, Edinburgh, makes a novel suggestion for the preservation of decaying sandstones from further decay. Certain compounds of alcohol-radicles with silica, when exposed to moist air, hydrolyse, deposit hydrated silica in a coherent form, and thus act, he says, as a cement. The ether can be thinned with alcohol, and is a very stable body as long as it is not exposed to moisture, and if a piece of rotten sandstone is treated with it, in the course of a few days the sandstone hardens up and the resulting cement resists the attacks of acids. Another correspondent of the same journal recommends lime wash as a preservative, saying that it is almost unequalled for the purpose, and points to the cottages of Wales and Cumberland as examples of its effectiveness.

THE average time taken by a ship to find its position by means of the present system of wireless telegraphy is, according to the *Faraday House Journal*, five minutes. The drawback to the method is that valuable time may be lost in calling up the land stations and in communicating the results to the ship. To get over this drawback it is now proposed that the direction-finding apparatus be placed in the ship and that the "radiophares" send out characteristic wireless signals during fogs. The ship's officer can thus locate their geographical direction relative to the ship and thus, by triangulation, find its position. The direction-finding coil is movable about a vertical axis over the ship's binnacle, and thus the positions of the radiophares can be read off at once on the card of the magnetic compass. The method has been perfected by the Bureau of Standards at Washington, and it is highly probable that it will soon be internationally adopted.

Miscellanea.

THE output of steel in South Africa last year reached a total of 21,988 tons.

THE works in Norway of the British Aluminium Company, Limited, have been reopened, after remaining closed for well over twelve months.

IT has been decided that the Birmingham section of the British Industries Fair in 1923 shall be held from February 19th to March 2nd. The official prospectus is now in course of preparation, and will be issued shortly.

A COMMISSION has been appointed by Danish Engineers' Associations for the purpose of investigating the steps which should be taken, so far as Denmark is concerned, in the matter of standardisation in the engineering industry.

THE plant required for the extension of the electric power station of the Indian Electric Supply Company at Cawnpore will cost, it is estimated, about a quarter of a million sterling. British manufacturers are to be invited to tender for its supply.

THE completion of the sixth instalment of the Cauvery power scheme, Mysore, adds another 13,000 horse-power to the capacity of the plant. When some of the older machines have been replaced by modern, and more efficient, ones, and the Krishnaraja Sagara plant has been completed, the total capacity will be 36,000 horse-power.

EFFORTS are being made to obtain permission for the Chefoo Harbour Improvement Commission to build some 250 miles of roads for the development of the immediate hinterland of Chefoo, on which the port's future is believed mainly to depend. The Governor recommended that the necessary authority be given, and the scheme is approved by Peking, the money to be provided by Chefoo.

THE first section of the work of improving the facilities of Kobe Harbour was recently completed, and the opening ceremony is to take place to-day. The work was begun in 1907, and was to have been completed before the end of 1918, but owing to the war operations were prolonged for nearly four years. The improvement will add greatly to the existing accommodation, which is inadequate to meet the requirements of the increasing trade of the port.

IN order to relieve the congestion on the telegraph service between Tokyo and Osaka, a plan is being considered by business men of the two cities for the establishment of a wireless telephonic service between the two points with Nagoya as the intermediate station. An application has already been filed with the Department of Communications for the establishment of a wireless telephone service between the two cities by the representative of the Daido Electric Motor Power Company, which is one of the promoters.

THE difficulties in connection with the foundations of the new coaling plant at Delagoa Bay have now, according to the *South African Mining and Engineering Journal*, been entirely overcome, and there is quite a visible progress with the ferro-concrete walls, &c. The machinery and steel structure were already on the spot a month ago, and erection on the wharfside was to be started directly. The contractors for the foundations expect to have them completed in about ten weeks. The foundation works on the wharfside are also well advanced.

A BRONZE medal to be designated the Faraday Medal of the Institution of Electrical Engineers will commemorate the fiftieth anniversary of the first ordinary meeting of the Society of Telegraph Engineers (now the Institution of Electrical Engineers). The award may be made by the Council not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

ON the evening of May 31st, 1922, a serious fire broke out in the works of "Werkspoor," at Amsterdam, the largest engineering works in the Netherlands. The greater part, consisting of pattern shop, turbine workshop, locomotive shops, model stores, and welding shop has been destroyed. Part of the foundry has also been destroyed. The most serious loss is probably the destruction of the turbines for the Dutch cruiser Sumatra, and of the engines destined for the steamer Bontekoe, of the Koninklijke Pakervaartmaatschappij. A large number of Diesel engines has also been lost.

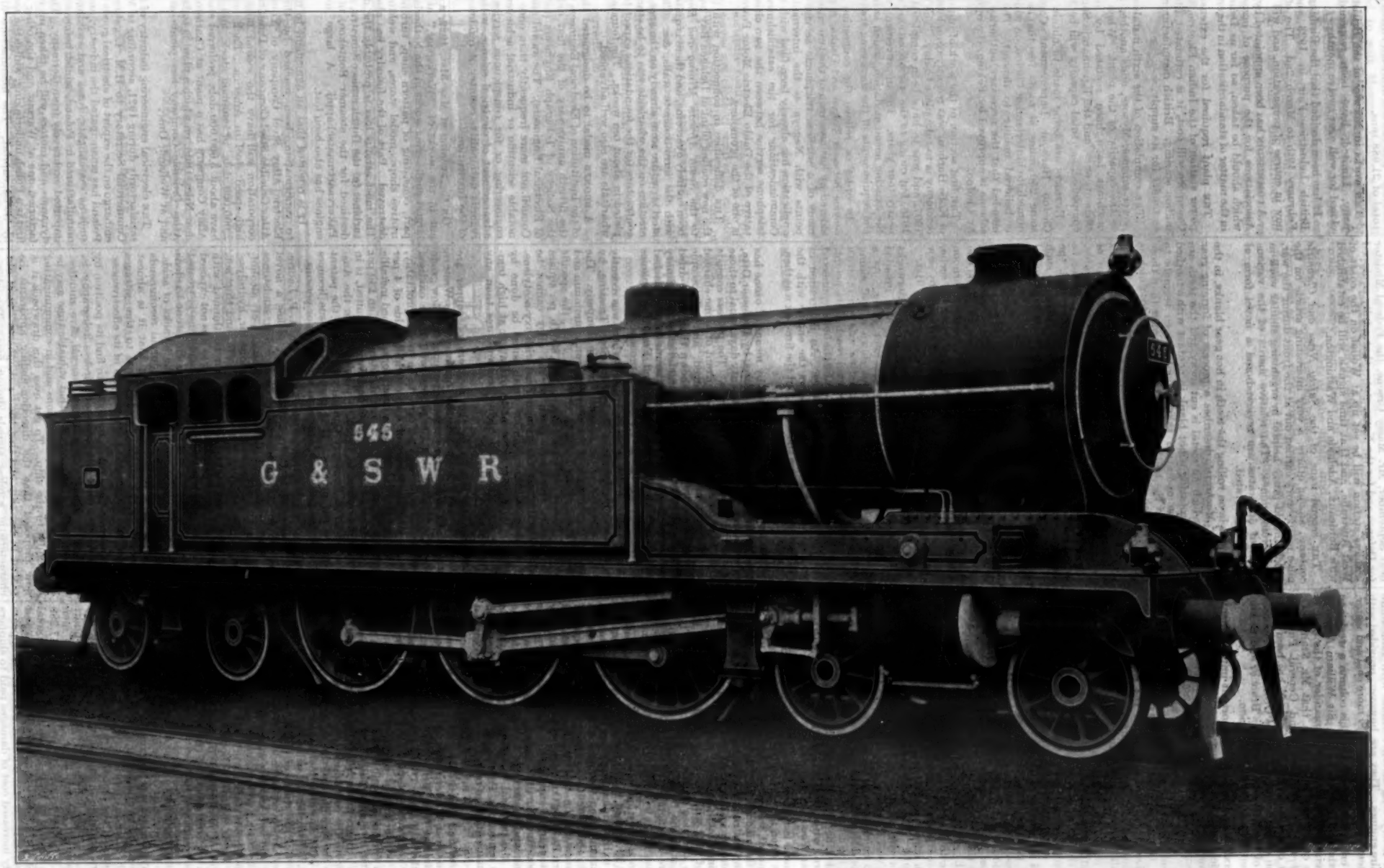
IT is reported that an agreement to merge has, subject to confirmation, been reached by the officials of the Electric Alloy Steel Company of Youngstown and the Atlas Crucible Steel Company of Dunkirk, N.Y. The new corporation will have the second largest production of high-speed steel in America. Each concern has about 2,000,000 dols. of common stock, and the two together have about 5,000,000 dols. preferred stock. The Electric Alloy Company has a plant at Charleroi, Pa., and a site near Niles, Ohio, on which a plant is to be built soon. The Atlas Crucible Company has plants at Dunkirk, N.Y., and at Welland, Ont.

THE electrical engineering industry of Poland developed satisfactorily during 1921, according to Mr. R. E. Kimens, Commercial Secretary to H.M. Legation, Warsaw. The embargo on the export of electrical goods from Germany to Poland has emancipated the industry, and certain articles, such as searchlights, fuses and switches, are now being manufactured in Poland, whilst before the war they were imported exclusively from Germany. The construction of dynamos and motors will be taken up next year by two factories, one at Warsaw and the other at Zychlin. The first is a Polish undertaking, whilst the second is subsidised by Swiss capital. The manufacture of cables has also begun, and two plants are in course of construction. Electric lamps are made in two factories in Poland, which are developing satisfactorily, but lately Dutch lamps have been offered and compete successfully with the local article. Although the import of goods from Germany is hampered by great difficulties and takes place only in a roundabout way, German offers are cheaper than those which are received from Holland, France, Great Britain, and other countries with a higher currency.

GLASGOW AND SOUTH-WESTERN RAILWAY—BALTIC TYPE TANK ENGINE

MR. ROBERT H. WHITELEGG, KILMARNOCK, ENGINEER

(*For description see page* 660)



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THE ENGINEER.

JUNE 16, 1922.

Cold Work.

THE treatment of metal by "cold working"—*i.e.*, the stamping, pressing or bending of pieces of metal into a desired shape in the cold, by the application of sufficient force—is undoubtedly a very attractive proposition from the production point of view. In the first place, it is so very much "cleaner" than any operation requiring the application of heat. The "messy" furnace, of whatever type, is entirely avoided, and with it the spoiling of the surfaces of the work by scaling or oxidation. Accuracy of finish also is attainable in the cold, which is difficult, if not impossible, to obtain when the metal is worked at a high temperature. There is the further attraction that the finished article is not only neater, cleaner and altogether better finished, but it is also appreciably stiffer and, at first sight, it is also stronger. With all these obvious advantages in mind it is, however, worth while to look at the other side of the picture and to inquire whether there are any serious disadvantages or limitations to the application of the process.

When the matter is looked at from this point of view the case is by no means so simple. In the first place, the process is obviously only applicable to metal possessing a considerable degree of ductility, and even then the amount of actual deformation which can be safely applied is strictly limited. The first consideration involves a very serious limitation in the choice of materials. If, for the moment, we think of steel, only the very mild varieties are found to be suitable. In "straight" carbon steels the limit lies at or even below a carbon content of 0.2 per cent., and this cuts out all the harder and stronger steels, which are rightly finding increasing use at the present time. Particularly where alternating or "fatigue" stresses have to be resisted, these very soft materials are not by any means desirable. It is true that cold working apparently hardens them so that they exhibit a raised yield point, but under fatigue stresses this hardening is illusory; the powers of resistance of the very mild steel is not really increased. This is particularly the case where the cold working has been unevenly applied, as is unavoidably the case in many forms of stampings and pressings, where parts of the piece are severely worked by bending, flanging or dishing, while other parts are practically untouched. There is, particularly in such cases, the further serious disadvantage that unequal deformation of different portions of the same piece inevitably entails the introduction of severe internal stresses. If such a cold stamping is cut into with a saw or other tool, the cut will usually either close up or gape, thus demonstrating the stress under which the metal has been held. These internal stresses add up with those applied in service and sometimes render even a small working stress dangerous. It is true that these internal stresses can be fairly easily removed by annealing at a moderate temperature; but if annealing has to be applied, some of the most striking advantages of cold working are lost. Annealing, moreover, brings with it a new set of dangers. A low-temperature annealing, between 600 deg. Cent. and 700 deg. Cent., is sufficient completely to soften the steel, but it not only removes the internal stresses and the temporary hardness due to cold working, but it makes the steel weaker and softer than it is in the condition in which it leaves the maker's rolls. This is due to the manner in which such a temperature, not only allows the ferrite crystals of the steel to reform, but also to the fact that the hardening and strengthening constituent—the "pearlite"—becomes rearranged. The iron carbide, which is the real stiffening factor in such steels, is normally present in fine plates or laminæ arranged in alternate bundles with thin plates of soft iron. After cold work followed by low-temperature annealing these plates disappear and the carbide is present in the form of fine little globules which contribute little or nothing to the strength of the metal. In this condition the steel possesses its lowest strength and elastic limit. This is useful if further cold work is to be done, as makers of weldless drawn tubing well know, but for service it is the weakest and worst condition. If a better condition is required—as it should be wherever strength is of importance—then the cold-worked steel must be "normalised," *i.e.*, it must be raised to a temperature well above its critical range and then cooled more or less rapidly. For these very mild steels this means heating to a bright red heat, such as 950 deg. Cent., followed by removal from the furnace and cooling in air. Treated in this way, articles of moderate weight attain their best and most reliable condition, but at the same time most of the advantages of "cold work" are lost, and there is undoubtedly the further risk that, unless very careful expert supervision is provided, the normalising temperature may be exceeded and the steel overheated or even burnt, or too low a temperature may be used and the steel damaged in another way.

The general conclusion to be drawn from these considerations seems to be that cold working is best applied to articles where no particular degree of strength or resistance to fatigue is required, and even in engineering construction there are many such articles which can be cheaply and satisfactorily produced in this way. For more serious purposes, however, the matter requires careful consideration whether hot forging, stamping or pressing is not in the end the better process. Hot working allows of a much wider choice of materials and provides a product far more satisfactory in real quality than the products of cold work, unless they are subjected to a careful normalising process, which in reality robs the cold-working operation of most of its obvious attractions. Similar considerations also apply to the use of such materials as cold-drawn steel and cold-drawn weldless tubing. In the latter case particularly, however, the application of proper heat treatment, which, preferably, takes the form of "normalising" before the last pass through the dies, supplemented for some purposes by the application of a lower temperature in what is known as a "blueing" operation, produces material which is not only indispensable for some purposes, but is actually of particularly satisfactory quality and reliability. The proper heat treatment is, however, essential, and it must be borne in mind that the qualities thus obtained cannot survive any subsequent heating which may be applied for such purposes as bending or brazing. Thus, cold-worked steel cannot be regarded as an entirely simple and satisfactory material; it can be used to excellent effect, but only if care is taken in its treatment and use.

Electric Power Stations.

ON account of high wages and the excessive cost of material the construction of power houses has become an expensive undertaking. "Before the war," states Mr. R. B. Mitchell, in his paper on the Dalmarnock station, read before the Institution of Engineers and Shipbuilders in Scotland in 1921, and presented again at the recent summer meeting of the Institution of Electrical Engineers, "the cost of the station would have worked out at £10 per kilowatt of plant installed, whereas the figure will now approach £20 per kilowatt for the first half of the station, and much more than that for the second half." Considering the general state of affairs and the elaborate lines

upon which the Dalmarnock station is built, Mr. Mitchell's figures are not surprising, but it is, of course, desirable that future stations should be built more cheaply. There is no power house in the United Kingdom or, possibly, abroad, that is better equipped than that at Dalmarnock, and although certain details have been severely criticised in America, the plant is nevertheless of considerable interest. The problem of driving the auxiliaries, for example, has been tackled in various ways, which were referred to on page 646 of our last issue, and which will serve as excellent bases for comparative purposes. Whilst it is as yet too early to state definitely which system or combinations of systems is the most economical to use, the operating engineers have ample means at their disposal for investigating the relative merits of the different arrangements. Similarly, as no fewer than three firms have built the main turbines, the engineers will soon be, if they are not already, in a position to judge which of the sets gives the best all-round results. Again, the installation of coal-weighing machines above the hoppers of each boiler has made it possible to obtain rapidly accurate information relative to the fuel consumed during each shift. Every effort has, in fact, been made to measure all the important quantities as accurately as possible.

Money spent on measuring instruments and appliances for large stations is not likely to prove a loss if these devices are properly used and looked after. There is no doubt that in the past much waste has arisen through the absence of proper measuring appliances. Boilers and generating sets may give perfectly good results at the time of an official test, but in everyday operation formidable losses are apt to occur if all the working conditions are not subjected to checking at relatively short intervals. All future large stations will, no doubt, be provided with better and more extensive measuring appliances than have been used in many stations in the past, and, as at Dalmarnock, a testing engineer may usefully be employed to keep a strict watch over the operation of those stations. One of the chief advantages claimed for the large electric power plant is, in fact, that it lends itself more readily to proper scientific management than do a number of small plants. But whilst fuel economy is, of course, very essential, especially at the present time, the question of reducing the capital cost is also important. Every endeavour should be made to simplify and cheapen the plant which is installed in new stations, for although no one can fail to appreciate the excellence of present-day power station machinery, its cost in these days is high. Papers which have been read before various institutions during the last two or three years have revealed the fact that some designing engineers, at any rate, are not overlooking the possibility of reducing the cost of power-house plant. Mr. Juhlin's paper, read before the Institution of Electrical Engineers last year, for example, advocated increasing the temperature rise of large alternators in order that smaller and cheaper machines might be built for a given output. The introduction of multi-exhaust 3000-revolution turbines and outdoor transformers are other examples of attempts to reduce the capital cost of large power schemes. Reliability is, of course, of paramount importance, and must not on any account be sacrificed for the sake of low cost. It is, however, well to consider in these days all schemes which appear to offer financial advantages. Switchgear for large power stations has been brought to a stage of perfection which perhaps can scarcely be improved upon, but inventors should not fail to try to discover whether equal reliability cannot be secured with less cost and complication. Whilst the switchgear that has been installed in some of the latest and largest stations is a credit to the makers, it must, we fear, be very costly. Similarly, in the case of condensers and their auxiliaries, the state of finality has not been reached.

Of the ideas which have been put forward of late in connection with power-house practice, air heating is one of the most interesting. But so many schemes are constantly being brought before power station engineers that it is not surprising that new ideas are not readily adopted. With all the latest and best machines and appliances the thermal efficiencies of power stations are still deplorably low. Speaking recently at a meeting of the Institution of Electrical Engineers, Mr. Selvey said that a station with a 25 per cent. efficiency was in sight, and that if the mercury vapour turbine proved successful an efficiency of 30 per cent. might be secured. Compared with the results which were obtained a few years ago, even 20 per cent. efficiency is remarkably good, although very far from ideal. Both from the point of view of efficiency and capital cost the modern power station leaves much to be desired, and there is still considerable scope for those with inventive ability.

The Railways' Road Transport Proposals.

The withdrawal, on Monday last, by its promoters, of the Bill that would have given the North-Western-Midland Group of railways powers to engage in road transport came as a great surprise. In face of the eleventh-hour conditions of the Ministry of Transport that there should be equal rates for road and rail, there seemed no other alternative. At the request of the Ministry the promoters, some time ago, gave the department a filled-in Bill, with the rates proposed and the safeguards set out. The Ministry subsequently reported on the Bill, but this point was not raised. Opposition of this character was quite unexpected, as the companies had conciliated many of their opponents. They had agreed not to carry passengers nor to manufacture their own equipment, and had inserted clauses that gave access to the Rates Advisory Committee. So far had the promoters gone that the Bill had the approval of many commercial bodies—although the Federation of British Industries could not be persuaded to modify its opposition. Even the Ministry of Transport gave its blessing to the principle of the Bill, inasmuch as Sir George Beharrell said on Monday that, provided adequate safeguards were contained in the Bill, a railway company should be given road powers where they were in the public interest. It is clear why the Ministry should ask that the road rates should be equal to the rail rates; it feared that the companies might attempt to gain traffic by road by undercutting its road competitors. It feared also that low road rates might lead to an inconvenient excess of traffic by road. Such rates might, it was thought, be put in force by the railway companies in order to save them spending large sums on widenings of the railway, electrification, &c. Such fears are, we consider, groundless. Conceding that it be true that the railways bought up the canals in order to kill them, they cannot do the same to the roads. It is hardly likely that they will charge such low rates by road that a private motor vehicle concern could not undercut them. What makes the situation worse is that the railways are big ratepayers, and pay their share for the upkeep of the roads. They have been led to seek for these powers because much valuable traffic was being sent by motor vehicles throughout and without touching the railway at all. This has, in part, been made possible by good roads, towards the cost of which the companies have paid. As we have said, the Ministry concurred in the companies getting the powers they sought, but, at the eleventh hour, it desired to insert conditions which ought to have been thought of earlier.

R. W. Thomson and Road Locomotion

By Colonel R. E. CROMPTON, C.B., R.E.

The town of Stonehaven is celebrating, on June 29th, the centenary of the birth of R. W. Thomson.

The great part played by Thomson in the development of modern road locomotion is, I am afraid, known to very few. He was the first and the real inventor of elastic or resilient tires of all kinds, first of the air-filled or pneumatic tire type, and afterwards of solid rubber tires in varied forms. He devoted many years of his life to the development and adoption of such tires to road locomotion.

In the year 1870 I was sent home from India by the Indian Government to arrange with Thomson for the supply of a fleet of road locomotives fitted with Thomson elastic tires. With these the Indian Government intended to carry on an experiment on a large scale, to ascertain how far mechanically propelled road trains could be economically used to supersede the existing bullock trains which were then the only means of transport on the beautifully surfaced and well-laid-out trunk roads of India.

When I arrived in England I found that Thomson was an invalid confined to his sofa, but his mind was extremely active, and I found him very keen on the possibilities of great developments of road locomotion. At that time he had already sent out to Labuan, in Dutch East India, his first rubber-tired locomotive, which had worked successfully. He had supplied others to various users in this country for hauling very heavy weights, and I found that the performance of these extraordinary vehicles, which he had called road steamers, was the subject of much acrimonious criticism by the makers of the ordinary rigid-tired traction engine of the day. Those who have bound numbers of The Engineer of 1870 and 1871 will find that for a long time in almost every issue of The Engineer letters appeared demonstrating the absurdity of the idea that rubber tires could ever be used on the highway; in fact, such user of rubber was demonstrated to be a ridiculous proposition, and one to be shown up at all hazards, as it interfered with the only legitimate and proper vehicle, the existing type of rigid-tired traction engine.

As before my arrival in 1870 I had already been experimenting in India with the first engine sent out by Thomson in 1868, and found that everything that he claimed for the rubber tires was warranted by the results that I personally had obtained, I naturally took part in the correspondence, and the Editor of The Engineer very kindly allowed me to reply to the letters not only under my own name but under the pseudonym of "Avellana," which is the Latin equivalent of my Christian name, Evelyn. So that I had a double answer in every issue.

During the time that I was in England superintending and looking after the design and manufacture of my fleet of road engines I was enabled by Thomson to carry out a number of experiments to compare the rolling resistance of rigid-tired wheels with that of rubber-tired wheels over surfaces varying from the granite-pitched pavements of the towns to the soft surface of newly ploughed land. The rolling resistance we then obtained for rigid tires varied from 55 lb. per ton on the pavement up to 70 lb. on macadamised, and as high as 400 lb. per ton on the soft land; but with the pneumatic tires which Thomson was then using we commenced at about the same figure for a macadam road of 70 lb. per ton, and did not exceed 120 lb. per ton on the soft land.

The experiments we then made very closely confirmed the results obtained by General Morin and Tresca in France. These were made at an earlier date, when the French began to improve the surfaces of their Grandes Routes Nationales.

During the time I was working in Thomson's room he gave me the whole history of his ideas on road locomotion. In 1845, the year I was born, he had taken out a patent for air cushion tires, which disclosed in every important particular the present pneumatic tire, which was re-invented many years later by Dunlop. Thomson's pneumatics consisted of an inner tube made of fabric which was rendered air-tight by rubber solution; the outer protection, which answers to the modern tire covers, was made of leather laced on in sections. He told me that in the years immediately following the taking out of his patent he had fitted a number of horse-drawn vehicles with these pneumatic tires, and the results were marvellous as regards the increase of comfort of riding in the vehicle; and he had then been much struck by the fact that these pneumatic tires "absorbed the obstacle," the phrase so often used by Michelin in his early advertisements of pneumatics; that is to say that instead of the wheel of the vehicle having to mount over or crush down obstacles which lie in the path of the wheel on the road surface, the obstacle sank into the soft tire, and little or no vibration was communicated to the vehicle itself.

Thomson told me that for many years he tried to obtain from the rubber manufacturers the impervious air-tight inner tubes he required, but that up to the year 1866 he was unsuccessful, so that when he required hauling machinery for the Labuan coal mines he began to experiment with solid rubber of great cross section in order that he might get approximately the same results as he obtained with the pneumatic arrangement; but in 1870, the year I am speaking of, the North British Company, although it manufactured splendid solid tires of huge size, would not guarantee the air-tightness of the inner tubes for the pneumatics which Thomson required.

Meanwhile the adoption of these large solid tires introduced many difficulties, all of which were successfully dealt with by Thomson. I used to make the experiments and report the results to him. I told him that when running at considerable speed with the tires that I was then using with my new large engines, 15in. wide by 4½in. thick, the wheel having an overall diameter of 6ft. outside the tire, the tires heated rapidly at high speeds, and at first we thought this was due to the friction of the inner surface of the rubber tire on the outer surface of the steel wheel on which the tire was mounted. In order to reduce the friction at this point the steel surfaces were polished and were pierced with a number of holes to allow the access of air between the steel and the rubber. We also tried to reduce friction at this point by applying powdered graphite into the inside of the wheel; but in spite of this precaution the heating still took place, and Thomson pointed out that it was due to the rapidly repeated change of form of the rubber when rolled over the road as a tire, and he practically discovered the hysteresis of vulcanised rubber, the factor which, when multiplied by the speed, gives us the total work and hence the heat developed within the substance of the rubber itself by continued change of section and form.

My work in India with the Thomson engine was fully described in the engineering publications of the time, and was the subject of a paper read by me at the Glasgow meeting of the Institution of Mechanical Engineers in 1878. I therein described many of the phenomena we met with and the extraordinary hauling capacity of the Thomson road engines. At one time we worked road trains of seventeen wagons, or, including the engine and the tender, nineteen vehicles,

the total weight of the train being over 70 tons, and the paying load being 40 tons of goods and 50 passengers. Under favourable circumstances we obtained speeds of 20 miles per hour. I was able to show that in fine weather on the Indian trunk road I could count upon obtaining a tractive coefficient of 65 per cent. of the insistent weight on the driving wheels of my engine. This figure is more than twice as high as is possible with rigid tires. Here we have the fact that by the year 1872, owing to Thomson's work and his development of the use of rubber for road haulage, we had obtained results which in all respects were as good as those that are obtained to-day, and in some points, *i.e.*, the proportion that the cost of running the train bore to the total load carried, our results have not yet been beaten. All this was due to the far-seeing advice of Thomson, who throughout gave me and my assistant engineer, Richard Muirhead, of his best. He never grudged to us praise for any original thoughts or ideas carried out by us, but modestly disclaimed the truth, which was that most of our ideas were due to his inspiration.

Although during my late years of work with the Road Board and with the Commercial Motor Users' Association I have had very unusual facilities for studying the steady advance of road haulage on rubber tires from the commercial point of view, I can never forget that every advance that has been made by the manufacturers of tractors and lorries using rubber tires has been principally due to the early work put at the disposal of the engineering world by R. W. Thomson and by those who followed and manufactured to his designs.

I am sure Sir Alexander Kennedy, Richard Muirhead, possibly Louis Sterne, and one or two others who are still alive, and who were in personal contact with Thomson, will agree that I am not overstating the case when I say that Thomson, whose centenary will be celebrated on the 29th, *is the real father of modern road haulage.*

But Thomson was a great engineer. He designed and had manufactured, I think, by John Elders, the first floating dock; it was sent out to Surabaya, in Dutch East India. Floating docks, now so common, have been hardly varied, if at all, from Thomson's original design. He made many other inventions, notably rotary engines.

Literature.

The Corrosion of Iron. By J. NEWTON FRIEND, D.Sc., Ph.D. Carnegie Scholarship Memoir. The Iron and Steel Institute.

THERE is no one in this country, and probably in the world, who has devoted so much study to the corrosion of iron and steel as Dr. Newton Friend, and the Iron and Steel Institute has done wisely in collecting a number of his papers on that subject and issuing them as the eleventh volume of the Carnegie Scholarship Memoirs. But let us say at once, as it is the only serious criticism we have to make of a valuable volume, that a collection of the kind has one defect. It is a play without an end; there is no *denouement*; we pass through a succession of very interesting scenes waiting for the fifth act in which the plot shall be unravelled. It never comes. True, towards the end of the book Dr. Friend develops his colloid theory of corrosion, and indicates his conviction that it may be applied successfully to any of the problems that have preceded it, but nevertheless we cannot help wishing that somehow or another he had wound the volume up with a summary of his work, that he had given us something quite definite to take hold of. It may be that no such conclusion is possible, that corrosion is such a variable and provoking phenomenon that no generalisation can be made about it. We should be glad if he had told us even that, if no more could be said. We learn instead that the play is still going on and that Dr. Friend has launched out into a research on the Relative Corrodibilities of Various Commercial Forms of Iron and Steel, in which not only the ferrous but many non-ferrous metals will be put through "field" tests—on round bars 1¼in. in diameter by 2ft. long—instead of laboratory tests. We could tell him something of the difficulties and disappointments of such tests, having ourselves, in conjunction with Mr. F. W. Harbord, conducted a series several years ago. We can only hope that Dr. Friend may be more successful in reaching definite conclusions than we were, and that, then, he will be able to give us the last act and wind up his fascinating drama.

Dr. Friend, as everyone who has made himself familiar with his "Corrosion of Iron and Steel," published by Longmans in 1911, knows, has an easy and attractive method of handling his subject. He must have done an enormous amount of reading, for he quotes freely from a great number of sources. But he always quotes well. He picks out just what he wants to make his point clear, and does not confuse his readers with exceptions, corollaries and parentheses. You can go straight on and find the path clear the whole way. Take the first memoir in this collection. It is entitled a "Critical Survey of our Present Knowledge of the Corrosion of Cast Iron." "Critical" might almost be left out. The author takes us through a long series of observations made in the "field" and in the laboratory and gives us as useful a summary of the knowledge gleaned in the last eighty years or so as one could desire. Here you may find the essential facts about the influence of arsenic, carbon, cobalt, manganese, nickel and so on on the corrosion of cast iron or learn how that phenomenon is affected by shape or temperature. As a convenient summary of all that is known about the corrosion of cast iron this memoir, which occupies some eighty-five pages, could hardly be beaten.

In the second memoir the protection of iron against rusting by the use of paints is examined. Friend himself showed long ago—1913—that it is worse than useless to pile up coats of paint upon iron that is to be submerged in water. One coat, and not too thick at that, is more effective than two or more. A second coat seems to undo the work of the first. A few figures from a table given by Dr. Friend may be of interest. The paint was ferric oxide and linseed oil; the exposure lasted for ten months. A plate painted *at the rate of* 7.3 lb. per 100 square yards lost 0.440 grammes; another plate given two coats of the same paint lost 0.631 grammes. That paint contained 50 per cent. of pigment. Take another case, a paint with 80 per cent. of pigment. With paint at the rate of 18.3 lb. per 100 square feet it lost 0.843 grammes against another plate with paint at the rate of 7.3 lb. per 100 square feet, which lost only 0.530 grammes. Altogether, a 50/50 paint appears to be the best, and a thin coat is better in every way than a thick one, and a single thick one better than two. Dr. Friend remarks that a standard paint is required to enable us to compare other paints. He suggests its composition.

The next section is wholly inconclusive. In a few pages it deals with the effect of strain upon corrosion, and succeeds in leaving us—like all researches into the subject—quite in the dark. The fact is that straining a metal alters its electrical polarity, and no one can be quite sure what may happen in a structure unequally strained. Dr. Friend's advice not to presume that a steel structure under strain is no more corrodible than an unstrained structure, in spite of laboratory evidence to the contrary, is sound.

In Part IV. the influence of temperature upon the rate of corrosion of iron immersed in water is discussed. It is unnecessary to say more than that tests, as far as they go, indicate, as one might expect, a pretty regular rise as the temperature increases.

Here and there in the memoirs already mentioned references to the author's colloid theory crop up, and the appetite for a full explanation of it is at the flood by the time Part V. is reached. In this part the author expounds his theory at some length. The fundamental experiments on which it is based are, first, that in flowing water the rate of corrosion diminishes as the rate of flow increases, whereas in acid the rate increases. We are not quite sure that the experiments are truly comparable. It was easy to run tap water over a specimen for prolonged periods, but acid could not be used in that abundant way, and the "flow" was secured by revolving the specimen at high speed in a vessel of acidulated water. There appear to us to be several objections to this arrangement. First, the rate of flow over the specimen could not be accurately known, for all the fluid would certainly rotate at some speed or another; secondly, the total quantity of acid as compared with the total quantity of water used in the flow experiment was very small; thirdly, the centrifugal action on the disc may have had some effect; and, fourthly, the centrifugal action may have affected the local density of the bath. We cannot see that the author made a control experiment by using the same apparatus with water, which would seem to be the obvious and proper course in a case of the kind. However that may be, the difference of action between aerated water and acidulated water caused Dr. Friend to look for a new explanation of corrosion, and his colloid theory resulted. Put very briefly in the author's own words (see page 104), it is: "The true cause of corrosion under these conditions (in a neutral medium) lies in the formation of colloidal iron hydroxide which catalytically assists in the oxidation of the iron, being alternately oxidised by the air and reduced in contact with the metal." For a further discussion of this ingenious theory we must refer our readers to the volume which lies before us—a volume which well merits careful reading.

Deterioration of Structures in Sea Water. Second (Interim) Report of the Committee of the Institution of Civil Engineers. Edited by P. M. CROSTHWAITE, M. Inst. C.E., and GILBERT R. REDGRAVE, A.M. Inst. C.E. London: Published by His Majesty's Stationery Office. 1922. Price 2s. 6d.

THE first report of the Committee of the Institution of Civil Engineers which is studying the question of the "Deterioration of Structures of Timber, Metal and Concrete Exposed to the Action of Sea Water," was published in 1920, and was reviewed in our issue of January 21st, 1921. It will be remembered that in 1916 the Council of the Institution of Civil Engineers applied to what was then the Committee of the Privy Council for Scientific and Industrial Research—and is now designated the Department of Scientific and Industrial Research—for a grant in aid of the researches of a Committee which it proposed to nominate to investigate, in different parts of the world, the effects of sea water on structures of various descriptions. The grant was made and a Committee of originally thirteen, but afterwards seventeen members, was appointed, with the late Sir William Matthews as chairman and Mr. P. M. Crosthwaite as secretary. Since the publication of its first report the Committee has had the great misfortune to lose its chairman, but the position is being ably filled by Mr. M. F. G. Wilson, while the places on the body rendered vacant by the deaths of Sir John Wolfe Barry and Mr. A. G. Lyster, and by the resignation of Mr. G. W. Humphreys, have been taken by Sir Cyril Kirkpatrick and Mr. L. H. Savile and Dr. W. C. Unwin.

The present work, though in no way comparable with the first report in point of bulk, nevertheless embodies much that is of interest. It contains, first of all, the report proper, which is largely a survey of the collection of subsidiary reports which follow it and which are, taken in their order:—(*a*) Report from Mr. L. H. Savile, M. Inst. C.E., Civil Engineer-in-Chief to the Admiralty, which includes statements from (1) Mr. C. H. Colson, M. Inst. C.E., on the action of marine borers in waters of the Mediterranean round Malta; (2) Mr. J. Brookes Hunt, M. Inst. C.E., on the condition of materials of construction of docks &c., at Portsmouth, exposed to the action of sea water; and (3) Mr. G. P. Hayes, M. Inst. C.E., having particular reference to Devonport; (*b*) Sir Robert Hadfield, F.R.S., on the preparation of various steel and iron specimens for the Committee; (*c*) Dr. J. Newton Friend on the weighing of the specimens; (*d*) Dr. G. Barger on the protection of timber against teredo attacks; and (*e*) Mr. C. R. Harrington on work done at the Marine Biological Station at Plymouth. Following the foregoing, there are an abstract from the *Bulletins* of the Public Works of the United States Navy on concrete structures in sea water, an abstract of a report by Mr. R. E. Bakenhus on tests of concrete specimens in sea water at Boston Navy Yard, and an abstract of a report of the American Wood Preservers' Association on the attacks of marine borers on piling in various parts of San Francisco Bay from 1914 onwards. Finally, there are abstracts from reports from correspondents of the Committee at Karachi, Brisbane, Auckland (N.Z.), Wellington (N.Z.), Colombo, and Halifax (Nova Scotia).

The book should form a useful complement to the first volume.

BOOKS RECEIVED.

The Journal of the Royal Agricultural Society of England. Vol. LXXXII. London: John Murray, Albemarle-street, W. 1. Price 15s. net.

America versus Europe in Industry. By Dwight T. Farnham. New York: The Ronald Press Company, 20, Vesey-street. Price 4 dols.

Model Steam Locomotives: Their Details and Construction. By Henry Greenly. London: Cassell and Co., Limited, La Belle Sauvage, E.C. 4. Price 6s. net.

The Principles of Mechanical Refrigeration. By H. J. Macintire. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 12s. 6d. net.

The Analysis of Fuel, Gas, Water and Lubricants. By S. W. Parr. Third edition. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 12s. 6d. net.

Jane's All the World's Aircraft, 1922. Founded by Fred T. Jane. Twelfth year of publication. Edited and compiled by C. G. Grey. London: Sampson Low, Marston and Co., Limited, 100, Southwark-street, S.E. 1.

Modern Tunnelling. By D. W. Brunton and J. A. Davis. With new chapters on Railroad Tunnelling. By J. V. Davies. Second edition. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 33s. net.

The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures. Fourth edition. By Milo S. Ketchum. London: McGraw-Hill Publishing Company, Limited, 6 and 8, Bouverie-street, E.C. 4. Price 30s. net.

A Dictionary of Applied Physics. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. In five volumes. Vol. I., Mechanics, Engineering, Heat. London: Macmillan and Co., Limited, St. Martin's-street, W.C. 2. Price £3 3s. net each volume.

Board of Education—Catalogue of the Collections in the Science Museum, South Kensington, with descriptive and Historical Notes and Illustrations: Aeronautics. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 1s. 6d. net.

Tables Centésimales pour le Tracé des Courbes (Chemins de Fer, Routes, Canaux, etc.). Par J. Bouchard, Ingénieur Civil, Ancien Elève de l'Ecole Spéciale des Travaux Publics de Paris. Paris (6e): Gauthier-Villars et Cie., 55, Quai des Grands-Augustins. Price 15f

Department of Scientific and Industrial Research, Fuel Research Board—Physical and Chemical Survey of the National Coal Resources: No. 1, Correlation of Data for the Yorkshire, Nottingham and Derbyshire Coalfield. London: His Majesty's Stationery Office, Imperial House, Kingsway, W.C. 2. Price 2s. net.

A Pocket-book of Marine Engineering Rules and Tables. For the use of Marine Engineers, Naval Architects, Designers, Draughtsmen, Superintendents and all engaged in the Design, Construction and Care of Marine Machinery: Naval and Mercantile. By A. E. Seaton and H. M. Rounthwaite. Fifteenth edition, revised. London: Charles Griffin and Co., Limited, Exeter-street, Strand, W.C. 2. Price 15s. net.

Electric Locomotives.*

By Sir VINCENT L. RAVEN, K.B.E., Vice-president.

THE subject of electric locomotives is attracting a good deal of attention at present in railway circles, and a number of papers have been written, mainly in the United States and on the Continent, describing various designs which have been worked out for different purposes. Little has been published, however, in England during the last few years, in spite of the fact that a good many new locomotives have been built and put into service for various countries. This is the more to be regretted, as England about one hundred years ago was the birthplace of the steam locomotive. It is only fitting, therefore, that English railway engineers should take an active interest in the design of locomotives which, while not superseding the older machine, may now, at all events, be regarded as a definite factor in the future development of British as well as foreign railways.

The complete design of an electric locomotive is a combination of mechanical and electrical engineering. The mechanical portions of the locomotive definitely affect the design of the electrical portions, and *vice versâ*, and each portion has to be worked out in detail, quite apart from the determination of the general scheme. It is not proposed in this paper to go into the many detail points of mechanical and electrical design which are, of course, of great interest to many engineers, but rather to deal with the more general questions of (1) the requirements which any locomotive must be designed for; (2) the various designs which have been worked out to meet these requirements; (3) the advantages and disadvantages of the various designs which have been completed.

There are broadly three classes into which locomotives on most railways may be divided according to the nature of the work to be performed or the class of train to be hauled, namely:—(1) Shunting; (2) freight or goods; (3) passenger.

It is not, of course, practicable to confine any class of locomotive strictly to the duties for which it is primarily designed. For instance, it is very desirable that a passenger locomotive should be able on occasion to haul goods trains, and goods locomotives frequently have to carry out a certain amount of shunting at intermediate stations. In fact, one of the most important points to be attended to in considering any design is the question whether the locomotive is well adapted to deal economically and conveniently with two or more different classes of traffic. Naturally, beyond a certain point, such adaptability may cost more than it is worth. How far it is advisable to go in this direction is a matter for individual judgment. This is referred to later.

Shunting Locomotives.—Locomotives of this class are required principally for marshalling trains in goods yards. There is no need for them to be capable of running at high speed. A maximum of 25 miles per hour will be ample. They should, however, be suitable for moving the heaviest trains in use. The tractive power must, of course, be limited by the strength of the standard draw gear, and on the British railways, at all events, this consideration will determine the weight on the drivers.

On British railways it is not possible to go much higher than 30,000 lb. draw-bar pull, and an adhesive weight of 60 to 65 tons should be sufficient. Compared with steam locomotives usually employed in goods yards, this is a substantial increase. It is, however, a great advantage to have plenty of weight on the drivers in order to start trains rapidly, and thus speed up shunting operations. On other railways, such as those in the United States, where the draw-bars can stand much greater pulls, rather more weight on the drivers can be usefully employed. For example, the New York, New Haven and Hartford Railroad uses a number of electric shunting locomotives in its Oak Point, Westchester, Stamford and Harlem River yards. These locomotives have a weight of 71½ tons all on the drivers. On the other hand, the Chicago, Milwaukee and St. Paul Railroad has four electric shunting locomotives, weighing 64 tons.

For this class of locomotive there is no question of complicating the design by considerations of steady running, adaptability to other classes of traffic, &c. The design should be as simple as possible, and, if practicable, the whole weight of the locomotive should be on the driving wheels. For anything in the neighbourhood of 60 tons it is necessary to divide the weight between four axles, in order not to exceed the permissible axle loading.

The simplest arrangement is undoubtedly the double bogie design, each bogie carrying a pair of geared motors. This is from several points of view the most satisfactory. The construction is cheap, and the maintenance easy, due to the facility with which a bogie can be removed for overhaul or repair of the motors and a spare bogie substituted. The author sees no reason why this general design should not be regarded as standard for this class of locomotive.

The buffers and draw gear may be mounted on the body, and the tractive effort transmitted from the driving wheels through the bogie centres; or the draw gear may be fixed to the outer end frames of the bogies and the inner end frames connected together by an articulating joint, thus removing all buffing stresses from the body.

The North-Eastern Railway have had in use on their Quayside line at Newcastle for seventeen years, two shunting locomotives which have given extraordinarily good results. They are of the double bogie type with buffers and draw gear mounted on the body. The following are a few particulars:—

Total weight	55 tons
Length	38ft.
Wheel diameter	36in.
Bogie wheel base	6ft. 6in.
Distance between bogie centres	20ft. 6in.
Number of motors	4
Horse-power per motor	160

Duty.—The locomotive is capable of hauling a load of 335 tons on the level at 14 miles per hour, and of starting up a gradient of 1 in 25 with a trailing load of 166 tons, and of hauling this load up the same gradient at 9.5 miles per hour.

These locomotives, of which an outline drawing is shown in Fig. 1, have been in service since 1905, and they have only been in the shops three times for thorough overhaul.

Their daily duty consists of about 14½ hours shunting work and 2 hours running with trains. Including the time for preparing, stabling, running to and from the shed, their daily service occupies about 18 hours, and, if required, they could do more. For the whole of the year 1921 the average cost per engine for repairs, inspection, preparing, cleaning, &c., was £103. This figure is rather high, as it included some special repairs to one of the locomotives which would not be required in an ordinary year. It may be compared with the corresponding figure for the steam locomotives doing the same class of work, which for the year 1921 would be about £610.

The particulars of the shunting locomotives on the New York, New Haven and Hartford Railroad and the Chicago, Milwaukee and St. Paul Railroad mentioned above are as given below in Table I.:—

TABLE I.

	N.Y., N.H., and H. R.R.	C., M. and St. P.
Type of locomotive	Articulated bogie	Double bogie not articulated
System of electrification	Single phase 25 cycles	D.C.
Voltage	11,000	3,000
Drive	Geared quill	Straight gear
One hour rating—		
Tractive effort, lb.	23,200	21,400
Speed, miles per hour	12.2	11.5
Maximum safe speed, miles per hour	25	35
Diameter of driving wheels	63in.	40in.
Total weight, tons	71½	64
Bogie wheel base	7ft.	8ft.
Distance between bogie centres	16ft. 6in.	22ft. 4in.
Number of motors	4	4
Horse-power per motor, one hour rating	150	165

Some particulars of the duty performed by the New York, New Haven and Hartford Railroad shunting locomotives have been published recently, from which it would appear that the average daily tonnage dealt with per locomotive at the Oak Point Yard is about 16,000 and the monthly mileage about 4500. The locomotives are kept in service twenty-four hours a day and are normally given a light inspection, requiring half a day, after 2500 miles. A number of these locomotives have worked twenty-four hours a day for thirty days without interruption.

Freight or Goods Locomotives.—The conditions which govern the design of freight locomotives differ in different countries, mainly in respect of the strength of the standard draw gear and the use of power brakes on the goods wagons.

On British railways, as already mentioned, it is useless to design a locomotive for more than about 30,000 lb. tractive effort, whereas in the United States there is no objection to 120,000 lb. pull. In other countries the draw gear strength may be intermediate between these figures. For example, in South Africa a pull of 60,000 lb. is considered practicable.

The question of what speed to provide for is a point for careful consideration. One of the great advantages of electrification on a railway is the possibility it affords of speeding up the slow-moving traffic. Apart from special conditions, only those lines will be electrified on which there is a fairly dense traffic. On many of our railways the traffic is not only dense, but is congested. This is mainly due to the precedence which has to be allowed to express passenger trains, while goods trains have to take such opportunities as offer of working through from station to station in the intervals between passenger trains. By increasing the average speed of the goods trains, the length of lie over at stations can in general be greatly reduced, as shorter intervals can be utilised. When a line reaches the point of congestion, the capacity can be increased by quadrupling or by electrification. The former is a very costly matter, and even if the congestion is relieved in this way the many advantages obtainable by electrification are not secured.

It is important, therefore, that the speed of goods trains should be raised as much as is practicable. On the British railways, due to the absence of power brakes on the wagons, the speed on the level must not exceed about 35 miles per hour, and must be less than this on falling gradients, in order that the train may be sufficiently under control to stop when required by signal. The only practicable way, therefore, to effect any substantial increase in the average speed is to increase the speed up the gradients. This can easily be done by providing a sufficiently powerful locomotive and designing it for the speed required.

The author considers that the standard goods locomotive should be capable of taking a normal train up the ruling gradient on any ordinary line in Great Britain at about 25 miles per hour. This should enable an average speed of 30 miles per hour to be maintained, which approximates to the speed of the local passenger trains. All trains, except the few passenger expresses, would then travel at approximately the same speed and the traffic delays would thereby be cut down to the minimum.

Where conditions are different, as in the United States, it is economical to have much heavier trains than in Great Britain. For example, the Pennsylvania Railroad has built an experimental locomotive of 4800 horse-power capacity, which is intended, with the assistance of a similar locomotive pushing at the rear, to take a train of 3500 tons up a 1 in 50 gradient 12 miles long at about 20 miles per hour, or a train of 5600 tons up a 1 in 100 gradient 24 miles long at about the same speed. Further particulars of this experimental locomotive are given below.

A good many designs have been worked out in different countries, and brief descriptions of the most important are as follows:—

(1) The North-Eastern Railway in 1914 built ten goods engines for working the mineral traffic on the Shildon-Newport branch line. These are of the double bogie type, as shown in Fig. 2; the two bogies being articulated, carry the buffers and draw gear on their outer ends. The following Table II. gives some of the particulars of these engines:—

TABLE II.

Gauge	4ft. 8½in.
Voltage and system	1500 direct current
Drive	Straight twin gear
Total motor rating	One hour 1100 H.P. Continuous 635 H.P.
Tractive effort	One hour 19,600 lb. Continuous 10,400 lb.
Speed	One hour 20.5 m.p.h. Continuous 22.8 m.p.h.
Length over buffers	30ft. 4in.
Total wheel base	27ft.
Rigid wheel base	8ft. 9in.
Width overall	8ft. 4in.
Height (pantograph down)	13ft. $1^9/_{16}$in.
Diameter of driving wheels	4ft.
Total weight of locomotive	74 tons 8 cwt.
Weight per driving axle	18 tons 12 cwt.
Weight of electrical equipment	24 tons 5 cwt.
Weight of mechanical equipment	50 tons 3 cwt.
Approximate height of centre of gravity	4ft. 6in.

These engines deal with the mineral traffic between the gathering centre at Shildon and the sidings at Newport, five electric engines being capable of doing the work formerly done by thirteen steam engines. It may be of interest to mention the cost of repairs, shed charges, &c., for these electric locomotives. Last year was exceptional, as the traffic on this branch was abnormally low, due to the coal strike. It is better, therefore, to take the year 1920, which may be considered a fairly normal year. The total cost for repairs, inspection, preparation, cleaning, &c., for the electric locomotives for the year 1920 came to 1¼d. per engine mile, of which repairs amounted to a little more than 1d. and shed charges a little less than ¼d. These figures may be compared with corresponding figures

FIG. 1.—*North Eastern Railway. Electric Freight Locomotive.* Newcastle Quayside Branch. 0-4 + 4-0 Type.

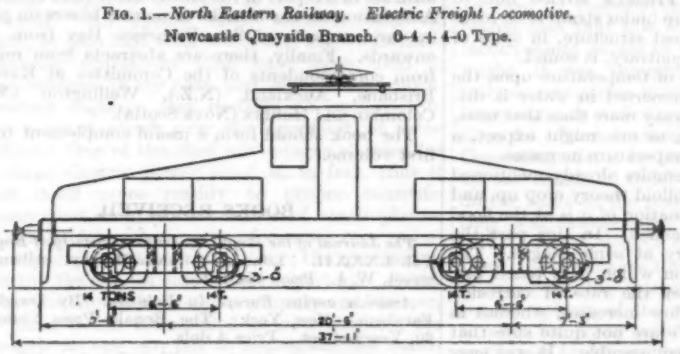
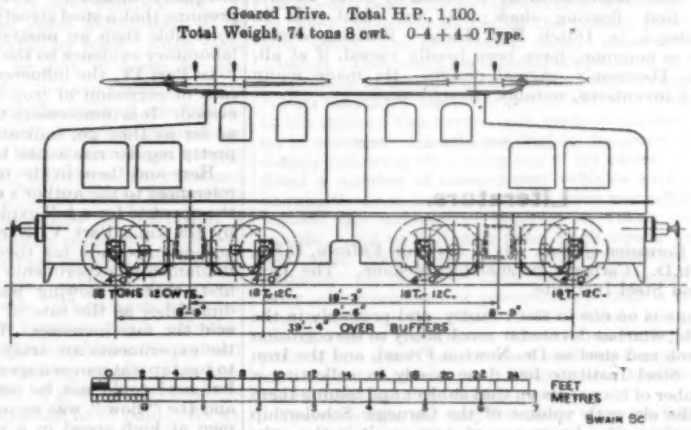


FIG. 2.—*North Eastern Railway. Electric Freight Locomotive.* Geared Drive. Total H.P., 1,100. Total Weight, 74 tons 8 cwt. 0-4 + 4-0 Type.



* The Institution of Mechanical Engineers, Paris Meeting, June, 1922.

for the same year for steam engines doing similar work, namely about 11½d. per engine mile total, of which the repairs alone would cost about 8d., and the shed charges about 3½d. The present-day cost, of course, is considerably below those ruling in 1920, and the author estimates that at the present time the corresponding figures for repairs, shed charges, &c., would be about 30 per cent. lower.

Locomotives of similar general design are in use on several railways in the United States, namely:—The Baltimore and Ohio Railroad, the Great Northern Railroad, the Michigan Central Railroad, the Butte, Anaconda and Pacific Railroad.

The Midi Company is building fifty electric locomotives, thirty of which are for omnibus passenger trains and

FIG. 3.—*Chicago, Milwaukee and St. Paul Railroad. Electric Locomotive.* Geared Type.

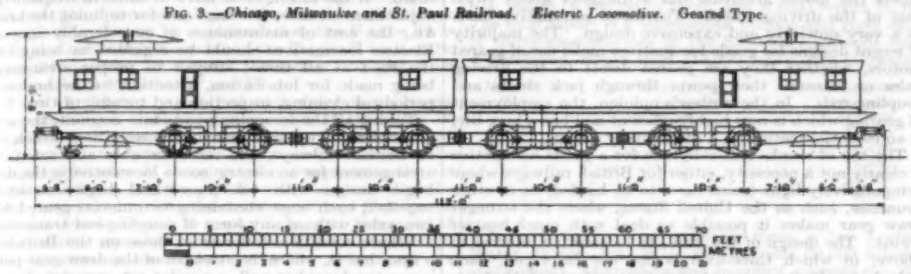
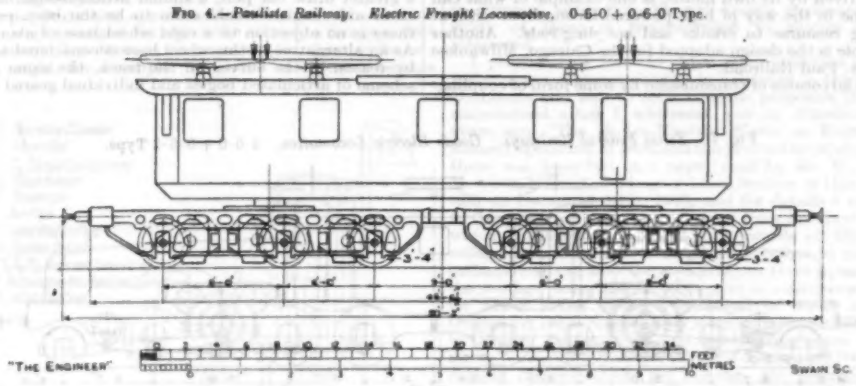


FIG. 4.—*Paulista Railway. Electric Freight Locomotive.* 0-6-0 + 0-6-0 Type.



twenty for goods traffic, and, in addition, it is building two experimental locomotives for high-speed work. The thirty passenger train locomotives only differ from the twenty locomotives for goods work in respect of the gear ratio. The locomotives are of the type B B—that is to say, they are mounted on two bogies, each of which has two motor driven axles. The total weight of the locomotive is 72 tons, and the capacity of the motors is 1000 horse-power continuous and 1400 horse-power on the one-hour rating. The passenger locomotive can attain a speed of 80 kiloms. (49.7 miles) per hour, and the goods locomotive 60 kiloms (37.2 miles) per hour.

The mechanical construction of these locomotives contains certain new features. The draw hook and the buffers are mounted direct on the bogies, and these bogies are articulated in order to avoid using the structure of the locomotive body for the transmission of tractive effort or buffing stresses. The pivot of one bogie is fixed on the body, while the pivot of the other bogie is mounted on a longitudinal slide, in such a way as to allow for a slight variation in the distance between two bogies on curves or in consequence of wear, without the underframe of the body being subjected to any stresses. Further, in order to obtain a better entry into a curve, and to reduce as far as possible the play on the rail due to dead weight, the period of oscillation of the body on the bogies has been increased as far as possible. The bogie pivots have been lowered and inverted in such a way as to put the axis of rotation as low as possible. The body is therefore destabilised, and is re-stabilised by means of two lateral spring supports on each bogie. These spring supports, by reason of their flexibility, allow the bogie to turn about their axis without any appreciable effort which eases the entry of the locomotive on the curve.

Finally, the lowering of the bogie pivot facilitates the balancing due to the running of the locomotive over irregularities of the track.

Each axle motor is connected to its axle by twin single reduction gearing. The gear wheels are fixed directly on the centres of the driving wheels in order to avoid any abnormal fatigue of the axles. The pinions are mounted on the two ends of the armature shafts of the motors.

In regard to the electrical equipment, the bogie motors are supplied direct with continuous current at a pressure of 1500 volts. Their capacity is 250 horse-power continuous and 350 horse-power on the one-hour rating. They are arranged for forced draught. The passenger locomotives can exert the power corresponding to their continuous rating by shunting the field windings between 50 kiloms. and 74 kiloms. (31 and 46 miles) per hour. For the goods locomotives the continuous rating, namely, 1000 horse-power is available in the same way between, the limits of speed of 30 kiloms. and 40 kiloms. (18.6 and 24.8 miles) per hour.

The locomotives B B, both the passenger and goods locomotives, are designed for regenerative braking, and on any given gradient are able to haul a train of the same tonnage as can be hauled up the same gradient by the motors at their one-hour rating. All the locomotives are fitted with multiple unit control. The control apparatus consists of two cam shaft controllers worked by auxiliary motors. Each motor possesses its own cam shaft, and constitutes therefore an independent unit. These cam shafts control the working of the motors in all series and parallel positions, but do not regulate the working when the fields are shunted.

The auxiliary motor is controlled from each of the drivers' compartments, one at each end of the locomotive. The power for the control circuits and for the auxiliary motor is supplied at 120 volts from a motor generator. This motor generator comprises a direct-current 1500-volt motor, which drives the generator for providing power for auxiliary purposes at 120 volts, and a variable voltage generator for excitation while regenerating, also two fans for the forced cooling of the main motors. The auxiliary generator is used also for the supply of the necessary current for lighting the train and for heating the locomotive alone.

Each locomotive is fitted with a mercury watt-hour meter, which records during the periods of regeneration. This meter is used not only to record the energy consumption of each machine, but also to interest the driver in economising the power consumption.

In addition to the regenerative braking, each locomotive is fitted with a Westinghouse brake, also with a separate brake for the locomotive alone and a hand brake.

The express locomotives will be of the type 2 C 2—that is to say, will possess three driving axles and two bogies. The one-hour rating of each locomotive is 2250 horse-power. The Midi Company is only building two of these locomotives, but these contain certain specially interesting features for experimental purposes.

Each locomotive will be equipped with three double vertical motors, each one being geared to a driving axle by means of double gearing, a hollow shaft and spring coupling. The two armatures of each double motor rotate in opposite directions, as so to neutralise their gyroscopic effect. The diameter of the driving wheels will be 1750 mm. (5ft. 9in.).

Each bogie motor will take power at 500 volts, and in normal working with the motors in parallel, three armatures will be connected in series. For series working, all the six armatures will be connected in series. These locomotives will be capable of giving their full output at a speed of 90 kiloms. (58.8 miles) per hour, and will be able to maintain the same output up to 120 kiloms. (74.5 miles) per hour by means of shunting the motor fields. The limiting speed of the locomotives will be 130 kiloms. (80.7 miles) per hour.

The motors will be controlled by cam shaft controllers just as in the B B locomotives, and will be fitted for multiple unit control. A motor generator reducing from 1500 to 120 volts will supply the direct current necessary for the different auxiliary services. The high-speed locomotives will not be arranged for regenerative control, as they have only to run on lines where there are no severe gradients.

(2) A very similar design is employed by the Chicago, Milwaukee and St. Paul Railway for their freight engines. The method of transmitting the power from the motors to the driving wheels is precisely the same, namely, by single reduction twin gearing, but the mechanical arrangement of the trucks is different, one of the main trucks containing a guiding bogie as well as the two driving axles. A general view of a pair of these locomotives is shown in outline in Fig. 3, and the following are some of the principal particulars of the design:—

TABLE III.

Gauge	4ft. 8½in.
Maximum tractive effort	132,500 lb.
Voltage	3000 volts d.c
Continuous tractive effort	71,000 lb.
Length overall	112ft.
Total wheel base	102ft. 6in.
Width overall	10 ft.
Height, pantograph locked down	16ft. 8in.
Rigid driving wheel base	10ft. 6in.
Rigid guiding wheel base	6ft.
Diameter driving wheels	52in.
Diameter guiding truck wheels	36in.
Total weight	257 tons
Weight on drivers	200 tons
Weight per driving axle	25 tons
Dead weight on driving axle	7½ tons
Weight per guiding axle	14 tons

(3) A recent design of freight locomotive for the Paulista Railway in Brazil is based on the use of two articulated bogies, but differs from the ordinary double bogie locomotive in that each bogie contains three driving axles and three motors. This arrangement, which is of interest in several ways, may be regarded as a development of the older design for the purpose of obtaining a greater tractive effort than is possible with four driving axles without any substantial departure from the simple method of drive by individual motors geared to the axles. The use of six motors enables the speed to be controlled over a wide range. The motors can be grouped (1) all in series; (2) three in series, two in parallel; (3) two in series, three in parallel. With each grouping, two speeds can be obtained by suitable alteration to the strength of the motor fields. Thus, six different speeds, ranging from about 6 to 21½ miles per hour, can be obtained with the same tractive effort of about 30,000 lb. Provision is also made for the use of regenerative braking by converting the motors into generators when the train is descending a gradient.

The mechanical parts and electrical equipment of the locomotive are designed so that ultimately—that is, when all the rolling stock has been equipped with M.C.B. couplers—two locomotives may be coupled up and operated as a single locomotive. The general arrangement is shown in Fig. 4, and the principal particulars are given in Table IV.:—

TABLE IV.

Type		0-6-0 + 0-6-0
Electrical system		Direct current
Voltage		3000
Total weight		104.6 tons
	One hour rating.	Continuous rating.
Capacity of locomotive	1680 H.P.	1350 H.P.
Tractive effort	29,400 lb.	21,600 lb.

FIG. 5.—*Norfolk and Western Railroad. Electric Locomotive.* 2-4-0 + 0-4-2 Type.

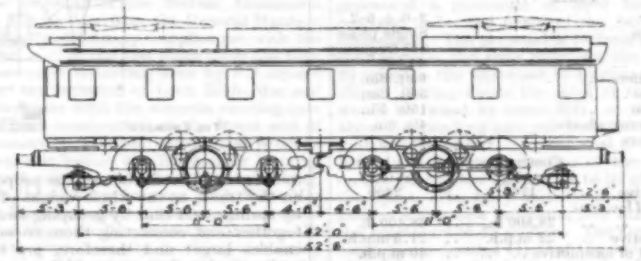
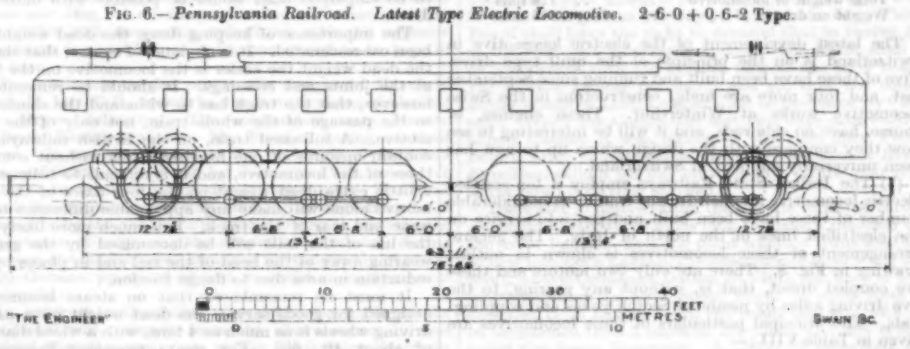


FIG. 6.—*Pennsylvania Railroad. Latest Type Electric Locomotive.* 2-6-0 + 0-6-2 Type.



Speed	21.4 m.p.h.		23.4 m.p.h.
Maximum safe speed			42 m.p.h.
Maximum tractive effort			58,500 lb.
Track gauge			5ft. 3in.
Fixed wheel base			14ft.
Total wheel base			37ft.
Length over buffers			50ft. 2in.
Wheel diameter			3ft. 4in.

(4) The locomotives employed by the Norfolk and Western Railroad for heavy mineral traffic through the Elkhorn tunnel are also of the double bogie design. The method of transmitting the power from the motors to the driving wheels is, however, quite different from the arrangement adopted in the examples referred to above. The

transmission is effected by connecting the two driving axles on each bogie to a jack shaft between them through cranks and coupling-rods. This jack shaft is driven by a pair of motors mounted on the bogie frame through single reduction gearing, the two pinions meshing with a single gear wheel mounted on the jack shaft. The arrangement is shown in outline in Fig. 5, and Table V. gives a few of the principal details of the design :—

TABLE V.

System	Single phase, 25 cycles
Voltage	11,000 volts
Gross weight per engine	245 tons
Weight on drivers	59,000 lb.
Capacity of motors, 1 hour	3000
Capacity of motors, continuous	2600
Tractive effort corresponding to the one-hour rating	87,000 lb.
Speed at this tractive effort	14 m.p.h.
Total length of double locomotive	105ft. 8in.
Rigid wheel base	11ft.
Number of motors per double locomotive	8

(5) The same method of power transmission has been adopted, but with a somewhat different wheel arrangement, for the experimental goods locomotive built by the Pennsylvania Railroad referred to above. This design is shown in outline in Fig. 6, and the particulars are given in Table VI.:—

TABLE VI.

System	Single phase, 25 cycles
Voltage	11,000 volts
Overall length	76ft. 6½in.
Total wheel base	63ft. 11in.
Driving wheel base	38ft. 8in.
Rigid wheel base	13ft. 4in.
Height from rail to top of cab	14ft. 8in.
Overall width	10ft. 1in.
Diameter of driving wheels	72in.
Diameter of pony wheels	36in.
Total weight	223 tons
Weight per driving axle	30 tons
Starting tractive effort	140,000 lb.
Normal working speed	20.6 m.p.h.

Many different designs of electric goods locomotives have been worked out on the Continent, and it is not possible to refer to all of them. Some have proved mechanically successful; others have been found unsatisfactory in one way or another. Many of the designs have been applied to one or two locomotives only, built mainly by way of experiment, and those which have been built in considerable numbers have been selected for mention only. There seems to be no signs, however, that any standard design of electric goods engine is being evolved on the Continent, as representing the general consensus of opinion of continental engineers.

(6) The goods locomotives employed by the Swiss Federal Railways for the electrified line from Chiasso to Lucerne through the St. Gothard Tunnel resemble in some respects the experimental locomotive built by the Pennsylvania Railroad. There are two pairs of motors, each pair being geared to a single jack shaft by twin gearing. This jack shaft is connected by cranks and side rods arranged on a special system to three driving axles. The complete locomotive consists of two trucks, each having a guiding axle and three driving axles and a low superstructure containing the motors and some of the control apparatus, together with a central body carried on pivots by the two trucks, which contains the main transformer and the principal part of the electrical equipment. The general arrangement is shown in outline in Fig. 7. The particulars of the locomotive are given in Table VII.:—

TABLE VII.

Type		2-6 + 6-2
Electrical system		Single phase 16⅔ frequency
Voltage		15,000
Length over buffers		63ft. 8in.
Total wheel base		54ft. 2in.
Fixed wheel base		15ft. 5in.
Diameter of driving wheels		4ft. 5in.
Number of motors		4
	Continuous rating.	1½ hour rating.
H.P. of locomotive	1700	2200
Tractive effort of locomotive	28,800 lb.	38,400 lb.
Speed of locomotive	22 m.p.h.	21.5 m.p.h.
Maximum speed of locomotive		40 m.p.h.
Total weight of locomotive		128 tons
Weight on drivers		104 tons

The latest development of the electric locomotive in Switzerland is on the principle of the quill type drive. Five of these have been built and running since September last, and four more are under construction in the Swiss locomotive works at Winterthur. These engines, of course, have no side rods, and it will be interesting to see how they compare with the design which up to now has been universally adopted in Switzerland.

(7) The Italian State Railways employ a ten-coupled electric locomotive for their freight traffic. A considerable number of these have been built and put into service on the electrified lines in the north of Italy. The general arrangement of these locomotives is shown in outline drawing in Fig. 8. There are only two motors and these are coupled direct, that is, without any gearing, to the five driving axles by means of Scotch yokes and coupling-rods. The principal particulars of these locomotives are given in Table VIII.:—

TABLE VIII.

Type	0-10-0
Electrical system	Three phase 15-16⅔ freq.
Voltage	3000 to 3300
Total weight	60 to 75 tons
Number of motors	2
Total power of motors	1850 H.P.
Normal speeds	14 & 28 m.p.h.
Wheel diameter	42½in.
Total wheel base	20ft.

In addition to those mentioned above, other designs have been worked out in which the central feature is a single large motor or a pair of large motors, mounted in the body of the locomotive, the drive being transmitted to several coupled axles by vertical or inclined connecting-rods and one or two jack shafts. These locomotives are not built on the bogie principle, the body being carried direct by the framework, which rests on the axle boxes of the driving axles.

In comparing these various designs, the first point to be considered is whether the motors drive direct or through gearing. It must be remembered that the cost of the motors alone is something like 30 to 40 per cent. of the total cost of the locomotive. Any design, therefore, which leads to an unnecessarily large and costly motor is clearly at a disadvantage. For a given horse-power the lightest and cheapest motor is in general the motor which runs at the highest speed. For a freight locomotive a suitable motor speed can only be obtained by the use of gearing, unless the motor armature has a diameter about twice that of the driving wheel. The latter alternative leads to a very unwieldy and expensive design. The majority of recent designs for goods locomotives make use of geared motors, whether they are geared direct to the driving axles or transmit their power through jack shafts and coupling-rods. In the author's opinion, the employment of gearing which is now highly efficient and has a long life, is an essential feature of a satisfactory design.

The use of cranks and side rods for a goods locomotive is clearly not a necessity, either for British railways where comparatively light trains have to be hauled, or in other countries, such as the United States, where the stronger draw gear makes it possible to deal with much heavier trains. The design of the Paulista locomotive referred to above, in which three-axle bogies are employed, each axle driven by its own motor, is one example of what can be done in the way of high-powered locomotives without having recourse to cranks and coupling-rods. Another example is the design adopted for the Chicago, Milwaukee and St. Paul Railroad.

The advocates of transmission by some form of coupling-rod contend that it reduces the proportion of dead weight on the track, as the whole weight of the motor is carried by springs, and that by grouping two, three or more axles together and connecting them to one or two motors, it enables larger and therefore, *pro rata*, cheaper motors to be employed than would be possible with individual drive.

The importance of keeping down the dead weight has been overestimated. It is obvious, of course, that the less the dead weight the easier is the locomotive on the track at the joints and crossings. It should be remembered, however, that the track has to withstand the shocks due to the passage of the whole train, not only of the locomotive. A full-sized train, on the British railways, will contain upwards of one hundred axles without counting those of the locomotive, and it is difficult to believe that a little extra dead weight on the four axles of the locomotive alone will make any appreciable difference to the wear and tear of the track. It is much more likely that the life of the rails will be determined by the gradual wearing away of the head of the rail and in places by the reduction in area due to flange friction.

It must be remembered that on steam locomotives designed for goods service the dead weight on a pair of driving wheels is as much as 4 tons, with a wheel diameter of about 4ft. 6in. For steam passenger locomotives having 6ft. 8in. driving wheels, the dead weight may be as much as 6 tons. For an electric goods locomotive, such as that built by the North-Eastern Railway for the Shildon–Newport line, the dead weight with 48in. wheels is not more than 4½ tons.

As to the advantage obtainable by the use of one or two large motors, instead of two or four smaller motors, while it is quite true that, other things being equal, the cost per horse-power falls as the size increases, the difference in favour of the larger motor is more than offset by the extra cost of the mechanical parts, due to the provision of the jack shaft with its cranks and bearings, and the various coupling-rods with their bearings. In addition to this, the framework of the bogie or truck carrying the axle and jack shaft bearings must be made specially strong and massive to stand up to the reciprocating stresses inherent in this system of drive. The experience with the locomotives on the Norfolk and Western Railroad, where, in consequence of fractures, the bogie frames had practically to be re-designed and rebuilt, is a practical proof of this. Trouble of a similar nature has been experienced on other locomotives in which Scotch yokes are employed.

Quite apart from the increase in first cost of the locomotive, arising from the introduction of cranks, jack shafts, Scotch yokes and coupling-rods, the question of maintenance cost is a matter of great importance. For satisfactory operation, it is essential that the jack shaft bearings should be kept in proper adjustment and good condition, and the permissible wear of the brasses is small. If the locomotives have to come in frequently for adjustment of these bearings and for re-lining the brasses, &c., the cost of maintenance is considerably increased. Electric locomotives should be regarded as being fit for the road at all times, subject to proper arrangements being made for lubrication, attention to the brakes and periodical cleaning, inspection and turning of tires.

Taking all the foregoing points into account, the author is definitely of opinion that for the conditions which apply to British railways, the most suitable and satisfactory arrangement for an electric goods locomotive is the double bogie design with two four-wheel bogies articulated together, each bogie containing two motors geared to the two axles without any form of coupling-rod transmission.

Where conditions differ from those on the British railways, that is, where the strength of the draw gear permits a greater draw bar pull, a similar arrangement, but with three axle bogies, would seem to be the best, provided there is no objection to a rigid wheel base of about 14ft. As an alternative, if this wheel base is considered too long by reason of the curves on the track, the same general scheme of articulated bogies and individual geared motors can be adopted by designing the locomotive in one way or another with a sufficient number of four-wheel bogies. For example, if a short wheel base is essential and the desired tractive effort makes it necessary to have 180 tons on the drivers, three double-bogie locomotives can be coupled together and operated as one.

(To be continued.)

FIG. 7.—*Swiss Federal Railways. Goods Electric Locomotive.* 2-6-0 + 0-6-2 Type.

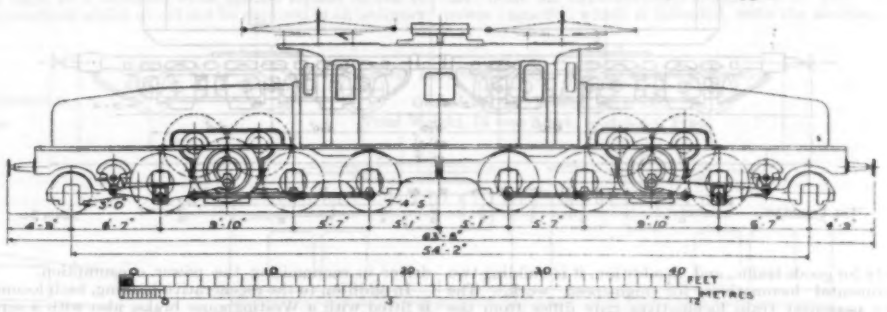
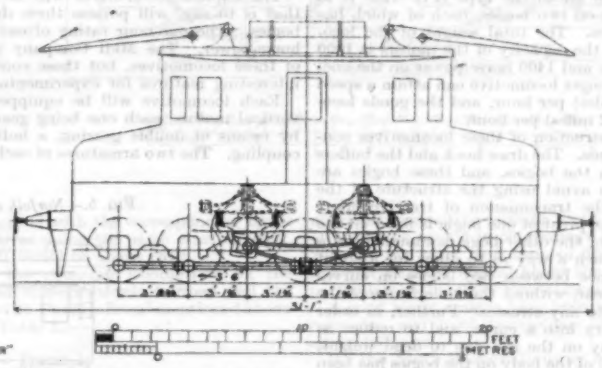


FIG. 8.—*Italian State Railway. Giovi Line. Electric Locomotive.* 0-10-0 Type.



The Allen Hydrautomat.

ON Monday last we were invited to witness a demonstration of the working of an apparatus to which the name of the Allen Hydrautomat is given, and which embodies a novel method of raising water, the motive power being falling water.

The arrangement, which is the invention of Mr. T. G. Allen, of the Allen Hydrostatic Pump Syndicate, Ltd., 106, Victoria-street, Westminster, S.W., will be readily understood by the aid of the accompanying illustration. In it the available head of water is indicated by the two broken lines marked "High level" and "Low level" respectively. In the example which we saw, which was in the upper waters of the Wandle at Carshalton, Surrey, the available head was, we were informed, about 6ft. About midway in the fall there is arranged a closed air-tight vessel A, which is called the operating chamber, and from which lead three pipes F, G, and H. The chamber can be fed with water from the head race B through the U-tube G, which is furnished with a control valve W. The chamber can also be emptied by the double U-shaped syphon pipe H. Both G and H are led into the chamber A at the bottom. The pipe F, on the other hand, proceeds from the top of the chamber, and is connected with closed containers C and C^1.

Suppose, now, that these two containers be primed, or filled with water, which is a necessary condition for starting

the apparatus to work, and suppose, too, that the valve W is then opened so that water is allowed to flow through the pipe G into the operating chamber A, the result is that the pipe H is filled and the water as it rises in the operating chamber compresses the air in that chamber as well as that in the pipe F, so that the water in the closed container C is forced into the open vessel D through the pipe T^1 and the water in the container C^1 is forced into another open vessel or reservoir E through the pipe T^2. When these operations have been completed the discharge from the syphon pipe H, by means of some such mechanism as that indicated by V, closes the valve W, and, the syphonic action in the pipe H continuing, a partial vacuum is set up in the container A and consequently in the pipe F and containers C and C^1. The effect is that water is sucked from the head race B into the container C through the pipe T, and from the open vessel D into the container C^1 through the pipe T^2. It may be explained that the U-tube T^1 is made just sufficiently longer than the U-tube T for it to be impossible to draw air through the former, and the same may be said of the tubes T^2 and T^3.

When equilibrium is reached and water is no longer being discharged from the syphon pipe H the valve W is again opened automatically by the action of the weighted lever, and water is allowed to flow once more into the operating chamber A, thereby again compressing the air in the chamber A and the pipe F, with the result that the water just sucked up into the containers C and C^1 is forced into the vessels D and E respectively, and the cycle of operations is repeated in the same order continuously, the only moving mechanism being the valve and its operating levers, &c.

In the particular apparatus which we saw the various tanks were arranged one above the other in a tier on a steel framework, but there is no necessity for them to be so; they might, for example, be placed at different heights

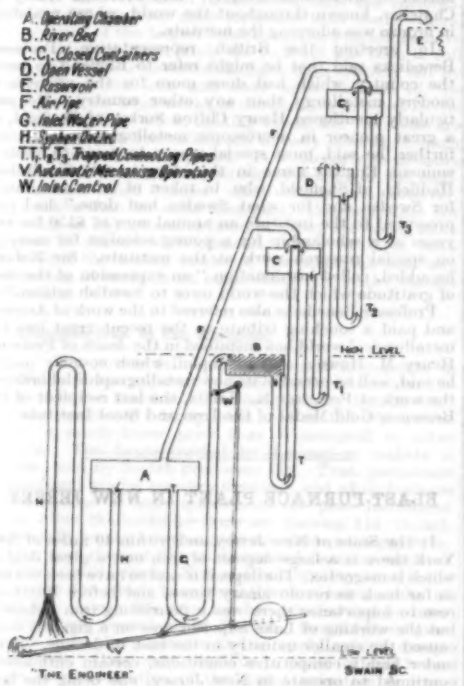


DIAGRAM OF THE ALLEN HYDRAUTOMAT

up the side of a hill. The water which was being raised when we saw the plant in operation was river water, but it might be from quite a different source, so that impure water might be employed to raise pure water or, for the matter of that, any other liquid.

It is to be understood that the number of lifts is not restricted to the number shown in the illustration, but is, according to the inventor, unlimited, so that water can be raised to any desired height. A controlling factor is that the capacity of the operating chamber must be at least equal to the combined capacities of all the closed containers. Another condition to be filled is that no lift can be greater than that due to the difference between the level of the water in the head race and the operating chamber A. In the apparatus which we saw at work the lift in each case was about 3ft. A corollary of this is that no matter what the total height to which the water is lifted, the pressure in no part of the system is in excess of that due to the effective head of water in the operating chamber. In this way Mr. Allen's invention, which, by the way, has been patented in all countries, differs from nearly all methods of raising water in practical operation. We are informed that the efficiency obtained with the Hydrautomat is from 80 to 85 per cent. At the demonstration the plant worked perfectly smoothly and silently, there being no jar such as is experienced with pumps of the ram type. It would seem that an entirely novel and apparently most effective means of raising water has been added to those which were previously available. It is possible to imagine a number of uses to which it might be applied with advantage, and among the first to suggest itself is irrigation; but it is too early yet to gauge the full possibilities of the invention.

ASSISTANCE, under the Trade Facilities Act, is being given towards the construction of a light railway between Portmadoc and Dinas. Mr. Neal said recently that work thereon was commenced on May 8th, and the number of men employed was 34. That number will be increased to 500 or 600.

Hydro-Electric Resources of the Scottish Highlands.*

By Professor MAGNUS MACLEAN, D.Sc., LL.D.

ON the 6th of June, 1919, I read a paper to the Institution of Electrical Engineers in Aberdeen on water-power, and I then summarised the natural sources of energy, as tides, food, fuel, wind, and rain. I referred more especially to the first interim report of the Water Power Resources Committee dealing with nine possible water-power schemes in the Highlands capable of giving 183,500 continuous E.H.P., and the average estimated cost per E.H.P. at the power-house was £38.5. Since that date the committee has issued a second, a third, and a final report in 1921. The final report is a voluminous volume and gives details of thirty-nine schemes in the Scottish Highlands which, if developed, would yield 189,000 continuous kilowatts.

Number of Table.	Number of Schemes.	Continuous kilowatts.
2	12	112,190
3	3	8,290
4	8	16,470
5	9	6,655
6	3	38,700
7	3	5,680
8	1	1,120

In addition to these schemes there is the Lochaber Water Power Act, 1921, which yields 23,000 kilowatts continuous. Alternative and modified schemes are given in different appendices by well-known engineers, and a study of these is recommended to anyone specially interested.

I propose this time to draw your attention to some water-power schemes already in existence in the Scottish Highlands and also to refer to some proposals that have materialised since I addressed you in Aberdeen three years ago. The Hydro-Electric Works at Foyers commenced operation in 1896, and the production of aluminium there was described in a paper read by Mr. W. Murray Morrison before the Glasgow Local Section of this Institution on December 10th, 1901, and for details I refer you to this paper. The water is derived from the river Foyers, which has a catchment area of upwards of 100 square miles. Two lochs have been joined together by dams and embankments so that the area is about three square miles, the storage being sufficient to give a continuous supply for about seven weeks. The head of water is 350ft. Originally there were seven large Girard turbines built by Messrs. Escher, Wyss and Co., driving seven vertical direct-current low-pressure Oerlikon dynamos of 700 E.H.P. each at 150 revolutions per minute. Mr. Morrison wrote me quite lately stating: "The old plant is still doing very satisfactory duty, but some years ago two further units were added, being Pelton wheels by Escher, Wyss and Co., and generators by Dick, Kerr and Co.; also one smaller unit was added."

On November 14th, 1911, a paper was read by Mr. Alfred Henry Roberts, to the Institution of Civil Engineers on "The Loch Leven Water-Power Works," and on the same evening a paper on "The Hydro-Electric Plant in the British Aluminium Company's Factory at Kinlochleven," was read by Mr. Frederick Bolton Sonnenschein. These two papers and the discussion occupy a hundred and fourteen pages of the "Proceedings," and are well worth careful study by anyone interested in the subject. The company that obtained the Act of Parliament in 1901 was the Loch Leven Water and Electric Power Company, but the construction was deferred, and in 1904 a revised scheme was submitted to Parliament and duly authorised. The factory work started in February, 1909. The whole of the works are now the property of the British Aluminium Company. Mr. W. Murray Morrison, the General Manager of the British Aluminium Company, supplies me with the following information:—"In the first place there has been an extension of the water collecting area by 6.1 square miles, arising out of the inclusion of Loch Eilde Mor and Loch Eilde Beag, together with the streams running into them. A dam has been constructed at the lower end of the former, and connection has been established between it and the main reservoir behind the Blackwater Dam by means of a reinforced concrete pipe about five miles long. At about two-thirds the distance between Loch Eilde Mor and the Blackwater Reservoir a side intake was constructed for the purpose of taking in the flow from the stream—Allt Coire Na Duibh, the pipe diameter to this point being 48in. and between the side intake and the Blackwater Reservoir 54in. A discharge chamber was constructed at the outlet with measuring weir fitted with the requisite apparatus for enabling a continuous record to be kept of the flow.

The work was carried out to the designs of Mr. C. S. Meik, M. Inst. C.E., under the direct supervision of the late Mr. Bryce Johnston. The contractors were Messrs. Balfour, Beattie and Co., Mr. Pitcairn acting as their agent. It was commenced in the beginning of 1916 and was sufficiently completed by January, 1918, to enable water to be taken in at the side stream intake. The work was fully completed and water flowing through from Loch Eilde Mor by the end of July, 1918. Owing to the extreme importance of increasing the output of aluminium during the war, the Government arranged for the supply of about 1000 German prisoners of war to assist in carrying out the work.

In order that the fullest use might be made of the additional water supply from the above source, it was decided that the main dam at the Blackwater Reservoir should be increased in height to the extent of 3ft. This has the effect of providing additional accommodation for 260 million cubic feet of water, making a total of 3320 million cubic feet of water, which is sufficient to maintain the whole of the plant in operation for a period of about three months. The plant as installed originally in the power-house consisted of nine sets of 2000 kilowatts capacity each, which together with the auxiliary generating sets for traction and lighting gave a total plant capacity of 19,150 kilowatts. An additional set of 2000 kilowatts was installed in 1914, consisting of a turbine by Messrs. Escher, Wyss and Co., of the same design as the original plant except that it is fitted with deflectors to each of the nozzles in place of the by-pass arrangement for obviating sudden increase in pressure in the pipes on the sharp reduction of the load. Further, the needles are operated by the governors by means of an oil pressure regulator. The direct-current generators are of similar type to the original plant and were supplied by Messrs. Dick, Kerr and Co.

In view of the additional water available from Loch Eilde Mor a further 2000-kilowatt generating set was ordered and installed in 1918. This consists of a turbine of the Pelton wheel type supplied by Messrs. James Gordon and Co. It differs from those supplied by Messrs. Escher, Wyss and Co., in that it is fitted with one nozzle only. The governor and needle gear is of the oil operated type, and a deflector is fitted to the nozzle, which comes into operation with sudden variations of load so as to prevent heavy increase in the pressure in the pipes which would arise if the needle gear was arranged to close quickly. The generators are identical with those previously installed. The total plant capacity is now 23,150 kilowatts for continuous running, with an overload capacity of 25,500 kilowatts. Considerable extensions to the reduction furnace plant were made, and in order to meet the increased demand for carbon electrodes arising out of the increase in the aluminium reduction plant extensive additions have been made to the carbon factory. These extensions enabled the company not only to maintain their own works in operation, but they were at the request of the Government during the war called upon to supply a very large quantity of electrodes for shipment abroad to works under the control of the Allies.

Arising out of the increase in output generally, and particularly out of the necessity of employing women during the war, the company has had to carry out considerable extensions in the way of housing accommodation, inclusive of the erection of three hostels, each of which accommodates 100 persons, and is self-contained in that it has its own kitchen, dining and recreation room, baths, &c. In view of the great importance during the war of maintaining the maximum output of aluminium, the Government decided to proceed with the long-talked of road between Ballachulish and Kinlochleven, so as to afford further means of communication beyond that already existing by sea. It is interesting to note that the maximum possible output of aluminium was maintained without interruption throughout the war, when it was, of course, of the utmost importance that the largest possible quantity should be placed at the disposal of the authorities. During the last twelve months the universal depression in the metal and most other industries has necessitated the temporary closing down of a considerable amount of the plant, but recently some of the plant was restarted and the works are now operating at nearly full load.

I shall now summarise two proposed hydro-electric schemes, namely, the Lochaber Power Scheme and the Grampian Power Scheme.

The catchment area of the Lochaber water-power scheme, promoted by the British Aluminium Company for the development of which an Act of Parliament was obtained last year, is 303 square miles. Taking the average rainfall as 73in., this gives 1056 million gallons per year per square mile, and therefore for the whole area 876 million gallons per day. The average head of water available near Fort William is 742ft., so that the theoretical horse-power is 137,300. The company estimates 72,000 to 75,000 continuous horse-power, which gives an estimated efficiency about 60 per cent., but it is anticipated that 100,000 horse-power will be obtained in all but the drier years. Now one horse-power year is equivalent to 6535 electrical units and to 10 tons of coal. Thus the Lochaber water-power would be equivalent to from three quarters of a million to one million tons of coal per year. Of the total generated a minimum of 5000 horse-power has been reserved under the terms of the Act for other industrial consumers. The proposal is to form a weir just below the confluence of the river Spey and the Markie Burn, about 2½ miles to the westward of Laggan Bridge in Inverness-shire. During floods the level of the Spey at the point would be raised by some 30ft., so that a small reservoir about 2 miles long and just under half a mile in its widest part will be formed. A great deal of discussion took place before the Select Committee of the House of Commons on this part of the scheme, as to its effect on the fishing of the Spey. The Spey Fishery Board wanted 100 million gallons a day as a minimum flow and refused an offer by the promoters of 45 million. The Committee by way of a compromise decided (1) that the water of the Upper Spey above the upper intake is not to be abstracted up to a flow of 30 million gallons per day; (2) that the Spey Fishery Board shall have the right to demand that in twelve days of the year (not necessarily consecutive), water shall not be abstracted until the natural flow of the river reaches 100 million gallons per day; and (3) that the conduit at the intake of Loch Laggan shall be increased by 75 per cent. When the Committee met two days afterwards to adjust clauses, it was intimated that the Spey Fishery Board, after consideration, preferred to have a flow of 40 million gallons per day on such days all the year round as the flow of the river allowed it.

The water so derived from the Spey is to be led through a conduit nearly three miles long to make a junction with the river Pattack, near the point where it turns westward to flow into Loch Laggan, the difference of level being from 860ft. above Ordnance Datum to 840ft. A dam is to be constructed on the river Spean about 3½ miles from the outlet at Loch Laggan, with the result that the loch will be lengthened from 7 miles to 10½ miles, and this is to be called the Spean Reservoir. A tunnel 3½ miles long connects the reservoir with Loch Treig, whose level is to be raised 36ft., or 1ft. lower than the top water level of Laggan. The power-house is situated on the banks of the river Lochy just above Fort William, and the tunnel connecting it with Loch Treig is to be no less than 15 miles in length. The waters of 14 streams are to be tapped on the way by vertical shafts varying in depth from 175ft. to 350ft. A description, with a map and a section, appeared in THE ENGINEER of March 4th, 1921, and I would refer you to that article for further details.

The Grampian water-power scheme of 1921, which conflicted with the Lochaber scheme, especially as to the utilisation of the water of Loch Pattack, was withdrawn. This year a modified scheme has been passed recently by a select committee of the House of Commons. The scheme

* Abstract of paper read at the Glasgow University before the Institution of Electrical Engineers, during the Summer Meeting.

is being promoted by the Hydro-Electric Development Co., and the object is to supply electricity for all purposes in the counties of Perth, Kinross and Forfar, and the parishes of Kingussie, Insh, Laggan, in Inverness-shire; Lismore and Appin in Argyllshire; and Buchanan, Drymen, Killearn, Balfron, Kippen, Fintry and Gargunnock, in Stirlingshire. Over fifty lochs, rivers and streams are involved in the scheme, but the chief ones are Lochs Ericht, Rannoch and Garry, the river Garry, Loch-an-Seilich, Loch-an-Ruin, the Truim, Bruar Water and the Mhaire Water.

The catchment area is 417 square miles and the proposed four power-houses can give out 56,000 horse-power continuously: (1) Tummel, 17,400; (2) Garry River, 7500; (3) Bruar Water, 4200; and (4) Loch Rannoch, 26,900. The power-house at Loch Rannoch is to be supplied by a tunnel from Loch Ericht, which is to be raised in level by 37ft. The storage capacity of Loch Ericht will be 80,000 million gallons; of Loch Garry, 410 million cubic feet, and; Loch Rannoch, 1000 million cubic feet or 10,000 million gallons. The first part of the scheme beginning with the Tummel would cost £2,603,000 and the whole scheme four and a half million pounds. It was stated, in evidence, that on the completion of the first stage, if they assumed a sale of 170 million units per annum, the cost per unit would be two-fifths of a penny.

The city of Dundee has increasing demands on its electrical station, and the Corporation had in view a possibility of buying electricity in bulk from the Grampian Company, provided an adequate supply at a low cost can be guaranteed. Failing satisfactory guarantees as to the amount and continuity of the supply of current by the company, Dundee had in contemplation a scheme of their own, but as they included the utilisation of Lochs Ericht and Rannoch, now granted to the Grampian Company, I need not give details. I noticed in the Press that Dundee withdrew its opposition to the Grampian scheme, provided the company undertakes not to run its cable through Dundee, and that permission to electrified construction should be limited to main line electrification of railways only. I noticed also that by a majority the Dundee Committee decided to enter into an arrangement with the company if the price of electricity be reduced to £3 per annum per kilowatt of maximum demand, and one-fifth of a penny per unit, provided that the company paid the standing charges, plus a fixed annual rental of £5000 in respect of the Corporation's electrical station, and provided also that the other conditions of the agreement should be satisfactorily adjusted between the Corporation and the company.

The Electrical Engineer of Dundee has recently written me to the effect that:—"As regards the supply of power to Dundee by the Grampian Company, as they have had to admit that they are unable to compete with the present thermo system in Dundee, the only possible hope is a combination of the hydro-electric stations with my present steam stations. Such a combination is able to show, on paper at any rate, a possible small saving in years to come as far as Dundee is concerned. Future saving, however, depends so much upon the possible cost of coal that it is very difficult for the Council to decide to give up control of its own generating station. There is a section who believe that the cost of coal will go up and in any case labour troubles will never cease, so there is an advantage in favour of water-power with its comparative independence of labour disputes. In short, Dundee is prepared to buy as soon as any one has current to sell—at a price."

I shall now describe to you two small water-power schemes making use of the water of streams without reservoir or batteries. The electricity generated is utilised in lighting and heating mansion houses and driving electric motors for farming purposes. The first is at Inshes. This hydro-electric installation is very interesting as it shows the possibility of harnessing the water-power of small streams in the north of Scotland, and there are hundreds of such streams. The scheme was prepared and carried out by Mr. E. J. Williams, Scottish Manager for Messrs. Edmundson's Electricity Corporation. The estate concerned lies 2½ miles to the south-west of Inverness. There the river Millburn, about 2½ miles in length, owes its present name to the fact that in quite recent times meal-mills driven by water-power were quite common in the Highlands, and there were no less than six such mills on this stream. The total output of these water-power meal-mills, four of them of the overshot type, was 40 horse-power. The average flow of the river is about 120 cubic feet per minute and the minimum within recent years 90 cubic feet, though during last year's drought it dropped to 50 cubic feet.

At the power-house there is installed a "Turgo" impulse turbine by Messrs. Gilkes and Co., of Kendal. The gross head of water is 320ft. It was found that with a head of 310ft. and a flow of 96 cubic feet per minute, the output of the turbine was 34 horse-power, and the overall efficiency, including 9.7ft. as the loss due to friction head, was 60 per cent. When the flow was 224 cubic feet per minute the output was 88.3 horse-power and the overall efficiency, including 53ft. as the loss due to friction head, was 67.4 per cent. Coupled to either side of the turbine is a compound wound generator of 22 kilowatts capacity. The installation in Inshes House, 1000 yards distant, consists of one hundred and fifty 30-watt lamps for lighting, a few heaters, a hot plate in the dining room, and a washing machine and irons in the laundry. The power-house is connected to the Inverness town network by a pole line 1¼ miles in length. Mr. Williams, writing in the *Electrical Review*, in December, 1920, two months after starting, said:—"The supply from the scheme has enabled the Inverness Local Electricity Works to dispense with a Sunday morning shift of two men, and it has also reduced the running hours of the steam plant by at least one hour per day, it being possible to start up half an hour later in the morning, and shut down at least half an hour earlier at night." Writing to me quite lately, he says:—"With regard to the Inshes scheme, I may say that now there are five farms and seven large houses connected to it, and that in each of the farms beside the lighting there are motors. The lines are at present being extended to the village of Culcabok, where it is intended to give the villagers a supply at a fixed charge per lamp per annum. The surplus current, which is fed into the town network, is quite as much as estimated, and for the year now just completed this amounted to 95,000 units. The current used locally by the farms amounted to a further 14,000 units. The scheme has in every way come up to expectation, and has aroused a good deal of interest in the North."

Messrs Allan, Arthur and Ure, Glasgow, have supplied me with information about a water-power plant which they designed and installed during 1921 near the head of one of the sea lochs in Argyllshire. The catchment area of the stream from which the power is derived is about 2 square miles, with hills rising on either side to over 3000ft. It was found that the minimum flow after six weeks' drought was 50 cubic feet of water per minute and the maximum twenty times this. Hence it was decided not to build a reservoir but to build a substantial concrete weir across the stream at a level 290ft. above the turbine house, which would act as an intake. The pipe line, which is about 2000ft. long, is carried underground to the turbine house situated on the bank of the stream and at a distance of about 50 yards from the dwelling-houses, to which the cables are led underground.

The turbine, which is of Messrs. Gilbert, Gilkes and Co's. make, is capable of giving 33 brake horse-power or 22 kilowatts at full load at about 650 revolutions per minute and passing 85 cubic feet per minute. The dynamo, which is direct coupled to, and on the same bedplate as the turbine, is of Messrs. Horace Green and Co's. make, compound wound and designed to give 85 ampères and 270 volts at 650 revolutions per minute. The plant runs continuously night and day, and no batteries are installed. In the mansion house there are over one hundred lamps and plugs for lighting, in the kitchen there is a cooking range consisting of two ovens, hot cupboard grill and six boiling rings, the total loading being 13.6 kilowatts. The hot water supply for the house is got from an electrically heated 45-gallon tank. Four electrical elements are fitted in this, each loaded to 1½ kilowatt, the temperature being automatically controlled by thermostat at any setting desired.

The whole scheme is designed for lighting, cooking, hot water heating, heating and drying by electricity, and thus 50 tons to 60 tons of coal are saved annually, as well as the expense and inconvenience of carting it for many miles to the house. Should additional heating be required, wood is burned in the fireplaces. There is abundance of wood on the estate, which is cut up by a 36in. saw, driven by a 12 horse-power motor at times of light load on the turbine. The installation has been running with complete satisfaction for eighteen months, the only expense being a few pounds for lubricating oil and replaced elements.

There are scores of similar Highland streams running to waste through sparsely inhabited glens and straths, which could be utilised for industrial and other useful purposes at comparative small expense. The rainfall varies at different parts of the Highlands, but you may take it that every square mile of catchment area, even in summer, will give an average flow of 180 cubic feet per minute or one electrical horse-power at 75 per cent. efficiency for every 3.9ft. of fall. Thus there exists in the Highlands in our lochs and rivers considerably over half a million potential horse-power, which should at once be utilised in establishing suitable industries in the places where the power is available.

THE INSTITUTION OF MINING ENGINEERS.

As previously announced, the seventy-seventh general meeting of the Institution of Mining Engineers will be held at Sheffield on Tuesday, Wednesday, and Thursday, June 20th, 21st, and 22nd, 1922. In connection with it the following programme has been arranged:—On Tuesday, June 20th, at 11 a.m., a general meeting will be held in the Cutlers' Hall, when the chair will be taken by the President, Sir John Cadman, K.C.M.G. The following papers will be submitted for discussion:—(1) "The Air-cooling Plant at the Morro Velho Mine, Brasil," by Eric Davies, B.Sc.; and (2) "Stainless Steels," by Dr. W. H. Hatfield. In the afternoon at 2.15 p.m., special tramcars will leave the Cutlers' Hall to convey members and ladies to the United Strip and Bar Mills of Steel, Peech and Tozer, Limited, and at 2.20 p.m., special tramcars will leave the Cutlers' Hall to convey members and ladies to the works of John Brown and Co., Limited, and the Brown-Firth Research Laboratories. At 7.30 p.m., there will be a dinner at the Grand Hotel, Sheffield. On the Wednesday, at 10 a.m., there will be a general meeting in the Cutlers' Hall, when the following papers will be submitted for discussion:—(3) "Methods of Working the Barnsley Seam of the South Yorkshire Coalfield," by H. Rhodes and M. Rhodes; (4) "Rock Temperatures in the Coal Measures," by J. Ivon Graham, M.A., M.Sc.; (5) "The Rate of Absorption of Poisonous Amounts of Carbon Monoxide by the Blood," by A. P. Veale (from the Mining Research Laboratory, Birmingham University). In the morning, also, there will be alternative visits for the ladies of the party to the showrooms and works of Mappin and Webb, Limited, and to the cutlery works of Joseph Rodgers and Sons, Limited. At 2.15 p.m., motor char-à-bancs will leave Cutlers' Hall to convey members and ladies to the City of Sheffield waterworks. In the evening, at 8.45 p.m., there will be a reception and dance at the Grand Hotel, by invitation of the President (Lieut.-Colonel H. Rhodes) and Council of the Midland Institute of Mining, Civil, and Mechanical Engineers. On the Thursday, at 9.12 a.m., there will be a visit to the Grimethorpe and Frickley Collieries, members leaving Sheffield by train (Midland Railway) for Cudworth. There will be an alternative visit leaving Cutlers' Hall by motor omnibus at 9.30 a.m., to visit Thurcroft Main Colliery and Harworth Sinkings. Additional visits have also been arranged to the following works and collieries on Friday, June 23rd:—Pope and Pearson, Limited, Normanton; New Monckton Collieries, Limited, Royston (M.R.); Manvers Main Collieries, Limited, Wath-on-Dearne (G.C. and M.R.); Wath Main Colliery Company, Limited, Wath-on-Dearne (G.C. and M.R.); "Coag" Miners' Lamp Supply Company, Limited, Barnsley (G.C. and M.R.); Tinsley Park Colliery Company, Limited, near Sheffield: Coke and by-product works only (Koppers coke-ovens and Humboldt washery, Hoyles dryer, drying and neutralising process for sulphate of ammonia); Denaby and Cadeby Main Collieries (only for members who are directly employed at collieries), Conisborough (G.C.R.); Houghton Main Colliery: Collieries, sinking, coke and by-product works, Darfield Station (M.R.); John Brown and Co., Limited: (1) Aldwarke and (2) Rotherham Main Collieries, (1) Parkgate Station (G.C.), (2) Rawmarsh (M.R.); Brodsworth Main Colliery; Bullcroft Main Colliery; Hickleton Main Colliery; Yorkshire Main Colliery; Markham Main Colliery; William Cooke and Co., Limited: Tinsley Steel, Iron, and Wire Rope Works, Sheffield; and Hadfields, Limited, East Hecla Works, Sheffield.

THE METALLOGRAFISKA INSTITUTET OF STOCKHOLM.

ON June 1st the newly constituted Metallografiska Institutet of Stockholm held its opening meeting. The head of the faculty, as it may be justly termed, is Dr. Carl Benedicks, Ph.D., a relative of the present Swedish Minister in London, Baron Palmstierna. There attended, for France, Mr. Delavaud, Minister; for England, Sir Colville Barclay; for Germany, the Prince von Wied; for America, Ira Morris, Minister; and for Japan, instead of the Minister Hata, who was unable to attend, Professor Hasegawa from Tobata. After an inauguration address by Professor Arrhenius, in which, *inter alia*, he drew a most interesting parallel between the ideas and labours of the alchemists of old and the metallography of our days, more especially as regards the metal "colouring" and metal transmutation, the President of the Institute, Professor Benedicks, addressed the foreign representatives present, who, he remarked, by their presence gave evidence of the truth of the saying that science would not be the last to benefit by a revival of international mutual understanding.

In addressing the French Minister, Professor Benedicks mentioned, as a great French name in the department of metallography, Professor Floris Osmond, the "Classical Master of Micrometallography," and Professor Henry Le Chatelier, known throughout the world, whose medallion in bronze was adorning the institute.

In greeting the British representative, Professor Benedicks said that he might refer to England as being the country which had done more for the progress of modern metallurgy than any other country. He particularly mentioned Henry Clifton Sorby, of Sheffield, as a great pioneer in microscopic metallography. He had further, he said, most special reason to point to another eminent English name in this department, Sir Robert Hadfield, of Sheffield, who, in token of "his admiration for Sweden and for what Sweden had done," had just presented to the institute an annual sum of £150 for two years as a scholarship for a young scientist for carrying on special research work at the institute. Sir Robert, he added, called his donation "an expression of the debt of gratitude which the world owes to Swedish science."

Professor Benedicks also referred to the work of America and paid a touching tribute to the recent great loss the metallurgical world has sustained in the death of Professor Henry M. Howe; also to Japan, which country might, he said, well be proud of its new metallographic laboratory, the work of Professor K. Honda, the last recipient of the Bessemer Gold Medal of the Iron and Steel Institute.

BLAST-FURNACE PLANT IN NEW JERSEY.

IN the State of New Jersey and within 40 miles of New York there is a large deposit of iron ore, a great deal of which is magnetic. The deposit is said to have been worked as far back as revolutionary times, and before Pittsburg rose to importance there was a flourishing iron industry, but the working of Lake Superior ores on a gigantic scale caused the smaller industry in the east to decline. Even under highly competitive conditions, certain enthusiasts continued to operate in New Jersey, one being the late Mr. James Wharton, who built three blast-furnaces at Dover in 1900 and worked them until 1911. They were idle until 1916, when the great demand for iron for war purposes caused Mr. Leonard Replogle and some of his associates in the American Vanadium Company to purchase the Wharton mining properties and re-start the furnaces, which remained in use during the remainder of the war period.

The principal mining property consists of 4100 acres, but there are 1000 more acres of mineral rights. The ore runs south-east to north-west for about twelve miles, and the deposit is practically continuous. Twenty-nine of the old workings have already produced about seven million tons of ore, and four are now being developed on up-to-date lines.

The best mine, one and a-third miles from the blast-furnaces, was worked for twenty years to 1887, and in 1917 was re-started under the name of the Replogle mine. It has been diamond-drilled for a linear extent of 8000ft. and proved to a depth of 1240ft., and is estimated to contain 27 million tons of ore. Since 1917 over 300,000 tons of ore have been mined from two levels, and the present normal production is about 900 tons of crude ore per day of two shifts of eight hours each. The crude ore averages 36 per cent. of iron, and since 1918 a great deal of it has been concentrated magnetically. About 30 per cent. is non-magnetic, and is treated in a wet concentrating plant. The concentrates average slightly over 60 per cent. of metallic iron, 13 per cent. of silica, and .032 per cent. of phosphorus. The two remodelled furnaces at Wharton are capable of producing 1000 tons of pig iron per twenty-four hours, or, say, 360,000 tons per annum. They rank with the largest in use, being 90ft. high and 20ft. in diameter. Each furnace has four Robert's stoves to heat the air blast, a pig iron casting machine of the conveyor type, twenty bins for ore, and two bins for coke. Lime is obtained from the company's quarry at Ogdensburg, about 20 miles away.

IT is reported that the Nord Railway Company of France is about to make experiments with a new automatic brake invented by M. Dailiet, chief of the Beauvais sector of the line. The brake is specially designed for use when there appears to be a danger of a collision.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

End of the A.E.U. Lock-out.—Back to Work.

ENGINEERS and industrialists generally throughout the Midlands and Staffordshire are expressing satisfaction with the result of the engineers' ballot, and are delighted that the wheels of industry, so badly clogged by the lock-out, can now begin once again to revolve. It will naturally take some time to restore normal working, but dislocations in this area are regarded as being already in a fair way towards adjustment. Let us hope that all concerned will now unite amicably to make good as far as may be that which has been lost. The free operation of the engineering industry is one of the first steps towards a trade revival, and now that this is possible, progress will depend very much on the assurance of its steadfast co-operation in pulling things round. Manufacturers now hope to see the revival in trade which they have anticipated for so long, and which industrial disputes have done so much to retard.

Revived Iron and Steel Prospects.

The Birmingham iron and steel market is this week greatly improved as the result of the coming of peace in the engineering industry. Everyone on the Birmingham Exchange to-day (Thursday) was more cheerful, and an immediate and rapid improvement in the iron and steel trade is now confidently predicted. It is believed that numerous large iron and steel consumers have good orders to place once stabilised trade conditions are restored. This district has been more fortunate than many others, and at some of the largest local foundries operations have been continuous, even while the lock-out has been in full force. The effects nevertheless have been severely felt by the Staffordshire iron and steel mills because of the stoppage of the large works in the districts devoted to the building of rolling stock, making tubes, &c. As these are now reopened, a few orders are already coming through for the iron and steel required. It is too early to measure the effect of the altered attitude of labour in the engineering and allied trades. More orders are, however, being taken than for some time past. Consumers are not operating on any extensive lines, but they are taking more interest in market developments. Few of them have more than the barest stocks of raw material, and any quickening of trade must make itself felt in the market forthwith.

Cheapest Iron in the Kingdom.

The severe fall in manufactured iron prices in the Midlands has apparently made Staffordshire iron the cheapest in the kingdom. Merchant quality bars of Staffordshire make have lately been sold at £10 10s. at the works, a much lower price than is accepted in other districts. The figure quoted by Lancashire makers is £11 10s., and by Scotch producers £12. True, quotations for merchant grades are very irregular, and while business has been done in some quarters at the price mentioned above, other Staffordshire firms are quoting £11, though they usually see the business go to concerns quoting £10 10s. For the best class of fibrous unmarked bars, as much as £11 15s. is still asked. Nut and bolt quality iron, some fair orders for which have recently been taken, rules at about £10, though this price has been shaded and business has this week passed at £9 17s. 6d., though this figure appears to be the minimum and to apply only in exceptional cases. Consumers continue to press for still lower prices, in consideration of the recent reduction in ironworkers' wages, but manufacturers contend that this has been discounted by the price reductions already conceded. There has been a brisker demand for all classes of finished iron this week, and the present low prices are not expected to continue for long. Makers of marked bars are expecting new orders as the result of the restarting of the rolling stock firms, and present inquiries are reported to be more promising than of late. The rapid cheapening of iron has enabled the ironmakers to recover a little of the advantage lost in competition with steel. Unless the relative price is prohibitive, iron is preferred for roofing purposes, tube making and other requirements where corrosive influences have to be considered. Foreign offers of material are rather more in evidence, and nut and bolt iron, of which increasing quantities are used, is obtainable from Belgium at £9 per ton delivered in Darlaston. There is not more than a moderate inquiry for galvanised sheets, and makers are stated to be prepared to shade the £16 figure for an attractive order.

Improved Pig Iron Market.

Pig iron this week is distinctly stronger, particularly foundry sorts. Sellers are speculating on the possibility of an early rise in values, but they are not prepared to refuse any orders they can pick up at current rates. Consumers' stocks are known to be low. Some of the foundries, in fact, have scarcely any iron with which to commence operations. Consumers count to some extent no doubt on the stocks at furnaces, but with so many furnaces idle, this would be a transitory factor in the event of pressure for quick delivery. It seems likely that the passing of the engineering trouble has come just in time to prevent the blowing out of some Midland furnaces. One, however, has had to be extinguished in the Barrow district, and there has been a good deal of stocking of material, a process necessarily costly and impossible to continue. Any real revival of demand, it is anticipated, will bring with it the starting up of furnaces which are in complete readiness for relighting. A cautious policy will, however, be maintained in view of the unprofitable character of manufacture, while the smelter has to consider the great difficulty of disposing of his forge material for which there has been little demand of late, even if the foundries become good buyers. In one or two cases this week larger sales of iron are reported. Where prices were slack before, they have now firmed up slightly, and the minimum values at date are Northamptonshire forge 70s. to 72s. 6d.; foundry, 80s.; Derbyshire forge, 72s. 6d. to 75s.; No. 3 foundry, 82s. 6d. at furnaces. Numerous makers quote in advance of these figures. There is a little increase in foreign competition, Belgian merchants reappearing with offers of pig iron, but the price of this material offers no advantage over home makers' terms.

Steel.

There are no signs of animation in steel. Cutting tactics continue largely to dominate the market. Some of the rates mentioned are very low indeed by comparison with the Association prices. Finished steel bars are variable. Some re-rollers, on the strength of the slight relief in railway rates and a small reduction in billet prices, are offering from £9 2s. 6d. to £9 5s., while other firms quote up to £9 10s. For bars of Lancashire make £10 15s. is asked. Billets and sheet bars remain steady at £7 10s. Continental shippers are endeavouring to recover a footing in the market, and their quotation for joists offers an advantage to English buyers of more than £1 per ton. It appears likely that some business will be done in that quarter. Other quotations offer no advantage over home makers' terms. There has of late been an active demand for some descriptions of mattress wire, and output has been considerably increased.

Rail Rates Burden on Midland Manufacturers.

Considerable attention has been given this week to the important and striking statements made by Mr. Cyril E. Lloyd, chairman of the directors of N. Hingley and Son, Limited, of Netherton, near Dudley, one of the largest and best-known firms in the Midlands, in stating the case for a speedy and substantial reduction in railway rates if the iron and steel industry is to resume its pre-war activity. The whole of the iron and steel industry in the South Staffordshire area, he said, was intensely discouraged by the prolonged pressure of railway rates on the trade. It was perhaps scarcely realised how the cumulative effect of these rates on inland trade tended to force business to the coast. Unless the railways did something to help the inland factories, which were clearly their best customers, it was certain that the industries must be forced to the coast, and it was a well-known fact that certain large factories in the Midlands were already taking such a step. Industrialists here realise that Mr. Lloyd's statements are only too true, and with him they fear that unless very substantial further concessions can be made by the railway companies to assist the export trade of this district, those portions of it which are not driven out of existence will be driven to the coast.

Birmingham Unemployment Returns.

The unemployment barometer in Birmingham continues its downward tendency. The figures for the week ended June 5th show 65,043 totally unemployed, against 65,688 for the previous week, a further fall of 645. The number on short time was 4510, compared with 4902.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THE iron and steel markets here are coming slowly out of the stagnation which always overtakes them during Whit-week. There has been no meeting in the trade for a full week and neither buyers nor sellers have quite recovered yet from the effect of the stoppage; nevertheless there is a brighter feeling now than has been the case for a long time, although there is not very much business actually being done. Most of the engineering establishments are opening, but the amount of work awaiting attention is not so great as some people expected it to be; and the orders for material from the engineering shops are not coming in very fast yet. There should be more done soon, but it seems doubtful whether there will be work enough to produce any effect on the market prices for material.

Metals.

The late improvement in the copper market seems to have come to an end for the present and prices seem to be settling down again, although the level of values promises to be higher than it was a month ago. There is, however, no rush at present to buy copper, at any rate in this district, although the prices are still moderate enough—at least for standard and refined ingot. In regard to manufactured copper and brass the prices have been raised rather unduly, in the view of consumers, as, for instance, in strong sheets. The difference between these and standard copper is now greater than it was before the upward move in the market. It is rather satisfactory than otherwise to find that the copper market is not advancing rapidly under speculative influences, because the time is not yet ripe for any great advance, and the result of such a movement would almost inevitably be a bad relapse. Although the prospects for consumption in this country are better than they were, it would be rash to suppose that consumption will increase quickly; and it would be a pity to see confidence in the market—which is now fairly good—shaken again by a sharp fall from a level obtained too quickly. All interests will be better served if the price is allowed to rise gradually so as to avoid any check. There is still a good deal of cheap scrap metal about, both scrap copper and old gun-metal, besides a large quantity of old yellow brass. Engineers can economise a good deal by using scrap gun-metal at the present time, in all cases where they are not bound down to some definite specification as to the constitution of the metal. The market for tin has been fairly steady considering the usual volatile character of this metal. For nearly three months the fluctuations on the London market have kept within about £6 per ton or roughly 4 per cent., and this is unusual steadiness for tin. Probably the steadying factor is the Eastern stock of metal, and if such a result is obtained by this means we might wish that the stock might be maintained indefinitely. The demand here is only moderate for engineering purposes, but apparently the tin-plate consumption is going on fairly well both in Great Britain and in America. There is no indication yet of any serious change in the market, and the prospect seems to be for steady prices during the next month or so. Lead has been a little easier for prompt and the backwardation has dropped to £1 per ton; but the collapse of the lead market, which some people expected in June, does not seem to be in sight. Spelter keeps steady and rather firm. The offers from the Continent are not great and the consumption by the galvanising trade is moderately good. The brass trade of course takes very little. The curiously low prices paid for old zinc continue. One used to reckon that scrap zinc was worth a little more than scrap lead; but for more than a year now the latter has stood at from £8 to £10 per ton above the former.

Foundry Iron.

The market here for foundry iron is perhaps a little better than it was, but there is not nearly so much inquiry or buying as was expected would be seen after the holidays. It is possible that the improvement is to come next week when the engineering shops get into their swing, but one is inclined to doubt whether this will be the case. The market here is now almost entirely supplied from the Derbyshire furnaces, and these still base their prices on 82s. 6d. per ton on trucks, although some sellers ask a little more, and there are reports of sales at a little less. Now and then one hears of a sale of Cleveland iron in Manchester, but this of course must mean that the consumer is willing to pay about 15s. per ton extra in order to secure that make. There are only one or two ironfounders who will now do this, and it seems probable that when the Cleveland ironmasters are again in need of the Manchester market they will find that 95 per cent. of the ironfounders here have got out of the habit of using their iron. The market for Scotch iron here seems to be a little stronger, and sellers are very firm. There should be a large demand when the textile machinery makers are all active again.

Manufactured Iron and Steel.

There is perhaps a little better demand here for finished iron and steel, but it is not very noticeable yet. The official prices are altered only slightly in the home trade, but there seems to be a tendency to ask less for export business, and ordinary steel plates are heard of at £9 f.o.b. The local consumer resents having to pay 20s. to 25s. per ton more than the foreigner, or the buyer for export to the Colonies.

Scrap.

Foundry scrap is a little more inquired for, but there is no definite change yet in the prices. Heavy steel melting scrap is firmer and some business seems now possible for the Lancashire dealer. Wrought scrap is quiet and steady.

The Birthday Honours.

Amongst the local recipients of the King's birthday honours is a well-known Manchester engineer, Mr. Edmund Nuttall, A.M. Inst. C.E., head of the firm of Nuttall and Co., civil engineers and contractors, who has been made a Baronet. Among the works carried out by Messrs. Nuttall some of the principal are the new naval yard at Walker for Sir W. G. Armstrong, Whitworth and Co.; dock work at Birkenhead for Cammell Laird and Co., Limited; dry docks on the river Tyne; the works of the Partington Steel and Iron Company at Irlam, and the Royal Liver building at Liverpool. They have also been responsible for tramway systems in several large towns and many other works both in this country and in the Colonies. During the war the firm carried out considerable work of national importance in connection with the Admiralty, and was busy on the North-East Coast, the East Coast and West Coast of England. At present it has under construction for the Manchester Corporation the new Barton power station. Sir Edmund's health has recently been the cause of some uneasiness. Another engineer to be honoured by the King is Major Sir C. G. C. Hamilton, who has received a Knighthood. Major Hamilton was apprenticed to Messrs. Scott and Mountain, for whom he travelled abroad. Later he was appointed manager of the firm of Drake and Gorham, Limited, electrical engineers, an appointment which he relinquished after he was elected Member of Parliament for the Altrincham division of Cheshire. Sir George is a director of one or two engineering firms. Sir William Kay, who also received a Knighthood, was last year the Lord Mayor of Manchester. He also had an engineering training and for many years has acted very efficiently as chairman of the Gas Committee of the Manchester Corporation.

The End of the Lock-out.

The news that the members of the Amalgamated Engineering Union have accepted the employers' proposals regarding the exercise of managerial functions has naturally been received with much satisfaction in this great engineering district. The dispute which is now terminated has been in operation since March 11th, and it is feared that incalculable injury has been inflicted upon this great national industry. No time is, however, being lost in local engineering works in reinstating as many men as possible in their former occupations, but although operations were formally resumed on Wednesday last it will be some time before the whole of the members of the A.E.U. will be able to resume work. In many establishments the unfortunate occasion has been taken advantage of for holiday purposes for the staffs, so that when normal business conditions have been again established, further breaks for holidays will be rendered unnecessary.

BARROW-IN-FURNESS, Thursday.

Hematites.

With the prospect of an early return to work of the engineers the hematite iron trade outlook is certainly

better. When the engineering shops get to work there will be an increased demand for special sorts of iron which have not been made of late. Apart from that the iron trade will no doubt show signs of more activity generally. At present the output is not all getting into customers' hands, but is being stocked in various quantities at some of the works. The local steel works are taking a quantity of the iron and, but for the deliveries abroad, there would not be much activity at the moment. The Continent is still taking deliveries of pig iron and a cargo has gone to Antwerp. There is every hope of the continental trade expanding in the future, and this is a source of comfort after such a period of listlessness.

Iron Ore.

The iron ore trade is bound to improve as the iron trade does. At present local mines are bringing up ore for local use, but there was a part shipment of iron ore to Antwerp during last week. This branch of the trade may expand. Some of the big mines are doing very little, but the prospect is brighter. Spanish sorts are arriving in a limited quantity and there are at present stocks at some of the docks, but not to any great extent.

Steel.

The steel trade in most branches is only dull, but the hoop trade continues to be fairly brisk. A cargo of hoop iron has been shipped to Euston, Texas, and has to do with the order from America for the new crop. There have been two cargoes of steel rails from Barrow for Kingstown. The prospect in the steel trade is still far from bright and at the present there are no signs of a revival.

Shipbuilding and Engineering.

The ex-German troopship Brandenburg has been purchased by Alfred Holt, and Vickers Limited have been entrusted with the work of reconditioning. It will be a three months' job.

SHEFFIELD.

(From our own Correspondent.)

The Local Situation.

THE practical settlement of the lock-out has put business men in good heart, and there is now every indication of the early restoration, in part, at any rate, of normal industrial conditions. A good deal of work has accumulated during the stoppage, and no time will be lost in taking up its execution. Men will be put on as rapidly as circumstances will permit. In some cases there must be some delay while furnaces and other plant are being got ready for use again, and local industry still contains patches of really bad trade. Departments dealing with shipbuilding, for instance, have few orders on their books, and some time must elapse before there is any considerable call for tool steel. The demand for engineers' small tools, such as twist drills, cutters, files, and hack saws, has increased wonderfully during the past week, and many machines which have long stood idle are busy again. The requirements of the automobile industry are also on a considerable scale, although not sufficient to make the steel makers really busy. Most branches of trade, however, are advancing upwards more or less, and the downward tendency of things seems to have come to an end. A good deal of work in mild steel is either on hand or coming forward, and additional furnaces are being lighted in the Lincolnshire district. Buyers to an increasing extent recognise that prices on the whole are now stable, and as nothing is to be gained by waiting they are disposed to order on a substantial basis. In fact, a stiffening of prices is believed to be not improbable. Unfortunately, the depression in the railway steel branches is as acute as ever, owing to the unwillingness of the British companies to build new rolling stock or to order materials on more than a hand-to-mouth basis. Continental makers have captured a large share of foreign business which formerly came to Sheffield.

The Lighter Trades.

More activity is developing in finished steel products such as hand tools for a number of trades, and there is some revival in colonial buying, which has been unsatisfactory for nearly a year. Good business has obtained lately in mining tools for home and export. Recent price reductions have stimulated business in various directions, while the constant rise in German quotations, if continued, will soon extinguish the margin between them and British prices. German competition is not nearly so serious as it was at the beginning of the year. There is a little revival in the cutlery and plate branches, but only three days a week are being worked on the average. The chief difficulty in conducting these trades is the financial stringency, which is creating unhealthy competition.

Pig Iron.

It is a good sign that several local steel houses are again inquiring for hematite pig for early delivery, as it indicates the existence of work which has been held up in consequence of the lock-out, and the early re-starting of the open-hearth furnaces. Only a few of these furnaces have been working during the dispute, and these only intermittently, and practically all the hematite ore orders were cancelled or suspended. As the Sheffield district is perhaps the largest user of such material in this country, the hematite market was much depressed by these cancellations, and its position would have been still worse but for the considerable buying from the Continent. As it was, prices eased somewhat.

The Position of Tungsten.

The recent advance of 2d. per pound on the quotation for tungsten powder was made to cover the rise in wolfram ore, from which it is made. The annual report of the Wolfram Mining and Smelting Company is interesting in the light it throws upon the problem of the future prices of the metal. It states that at the price of ore now ruling it is impossible for the company to operate at a profit, but the present margin between profit and loss being small, it hopes to continue working for a considerable time. To-day's quotation for wolfram is from 12s. to 13s. per unit, while last September it was 13s. and 13s. 6d., with ferro-tungsten at 1s. 9d. per pound compared with 1s. 5d. to-day. The report states that the demand for wolfram ore, with the exception of Germany, was insignificant throughout the year, and prices were below the pre-war figure. The German demand was chiefly met from accumulated stocks in China. Information is to hand that 13s. per unit is almost a profitable basis for Chinese ore, and if that be the case, the Burmese mines will eventually have to close down and lose their ascendancy as the principal wolfram producing sources. That means that the control of wolfram will pass beyond the Imperial border.

Ferro-alloys.

At the time of writing new business in ferro-alloys continues slack, the recent improvement falling off with the Whitsun holiday, so that there is nothing of any moment to report, and prices are unchanged. Ferro-silicon is steady in both grades, and an inquiry for a fair parcel for the East is noted. The crucible steel furnaces have been closed entirely during the holiday, so that the demand for alloys from this quarter is negligible. Several large parcels of low carbon ferro-chrome have been bought by local users during the last two months. The business has gone mainly to Scandinavia, where makers have undercut French suppliers. French ferro-chrome is consequently nearly off the market. Nickel, aluminium, and cobalt are all quiet with prices easy. The nickel-silver industry is only moderately busy, and the spoon and fork industry is not very brisk. The so-called stainless nickel-silver is still selling freely for spoons and forks.

Fuels.

Despite the fall in values, the export demand for steam coal is only of a moderate character, and inland consumption has been reduced to negligible proportions by the engineering dispute. Prices are being cut. The holidays have been prolonged beyond the usual limits this year. Best hards are quoted 26s. f.o.b., and secondary grades several shillings below that figure. For washed smalls a good market exists, with values down to 17s. 6d. for export. The shorter working at many pits is accentuating the difficulty of obtaining an adequate tonnage of good coking slacks. As an early demand for blast-furnace coke is anticipated, ovens which have been idle for twelve months are being prepared, but the market is quiet for the moment. The supply of best gas coke exceeds the demand, but there is a call for best rough slacks. The house coal market has suffered from the hot weather. Approximate prices at the pits are: Best hand-picked branch, 37s.; best Silkstone, 33s.; Derbyshire house, 26s.; Yorkshire hards, 23s.; Derbyshire ditto, 21s.; rough slack, 8s. to 10s.; blast-furnace coke, 17s. 6d.

Siemens Furnace Practice.

The adjourned meeting of the Iron and Steel Institute, which was held at Sheffield on Tuesday farther to discuss the paper on "British Siemens Furnace Practice," read by Mr. F. Clements at the annual meeting of the Institute, was numerously attended, the local metallurgists being well represented. Mr. E. H. Saniter presided, and Professor Desch welcomed the visitors on behalf of the University of Sheffield, in the buildings of which the meeting was held. There was an interesting discussion extending over several hours, those participating in it being Messrs. Ridge, Kemp, Christmas, Brearley, Swinden, Ibbotson, A. T. Baker, Methley, Foster, Kilby, and others. All who took part spoke eulogistically of Mr. Clements' work, and were convinced that the results of his investigation would be of great value to the steel industry of this country. Mr. Clements replied at length to questions and criticism of detail, in the course of which he said he set out in his paper to endeavour to correlate what was commonly known as theory and practice. These, however, were in essence one, and must be married before it was possible to make much progress. He paid a tribute to the workmen in the steel foundries. He had found them to be sober and earnest-minded men, who were keen to co-operate in any efforts for improved practice. He had received valuable assistance in his investigations from the furnace workers.

After the Lock-out.

Employers in this district have given instructions for their locked-out men to report themselves at the works forthwith, and employment will be found for as many of them as possible. The absorption will, however, be gradual, as some important branches have no weight of orders on hand, and at others business has been cancelled or suspended. A few of these orders, however, are to be proceeded with, and instructions for resumption of execution and delivery are being received on a fair scale. Full time all round may be a long way off; nevertheless, next week will see a big reduction in the ranks of the unemployed. On both sides good feeling prevails, and men and employers alike are thankful that the dispute has come to an end. The heavy engineering shops are in a position to set on most of their men, as they are greatly in arrears with orders.

NORTH OF ENGLAND.

(From our own Correspondent.)

A Brighter Trade Outlook.

THE settlement of the engineers' dispute has inspired general optimism in commercial circles in the North of England regarding the trade outlook. It is well known that a considerable amount of trade has been held up by the prolonged dispute, and now that the air is clear it is expected that there will be a marked trade revival. Not all the engineers in this district will get back to work, as there is not work for them all, but still the industrial situation generally has been vastly improved by the re-establishment of peace in the engineering trade and an immediate expansion in business is confidently anticipated. In the iron and steel trades, which have been particularly hard hit by the dispute, preparations are being made in anticipation of better times in the very near future. After many weeks' delay Cochrane and Co. have blown in a blast-furnace at their Ormesby Ironworks. Of the twenty-seven furnaces now in blast on the North-East Coast, six are engaged on Cleveland foundry iron. In ordinary times there are seventy odd furnaces in operation, and although very many months must elapse before normal conditions return, the outlook is distinctly hopeful. It is an open secret that but for the engineers' dispute at least half a dozen more furnaces would now have been at work.

Cleveland Iron Trade.

Business still continues on a restricted scale on the Cleveland pig iron market. There has been some little accumulation of stock over the Whitsuntide holidays, and makers are eager to dispose of this before increasing the output to any extent. More furnaces will, however, be speedily put into operation if the anticipated expansion in the demand for iron takes effect. The foreign trade has fallen away to some extent. There has been a shipment of 3000 tons of pig iron to Germany this week, and another cargo is loading for the United States, but new overseas business is mostly confined to small parcels, the result being that the output has exceeded the consumption. However, all that will speedily be altered, and in the meantime prices are well maintained. No. 1 Cleveland pig iron is still scarce at 95s. per ton, but all other qualities are freely offered for prompt delivery—No. 3 G.M.B. at 90s., No. 4 foundry at 87s. 6d., No. 4 forge at 85s., and mottled and white iron at 80s.

Hematite Pig Iron.

East Coast hematite makers are looking for better trade, with the brighter outlook for steel, but it is a fact that during the last week or so even 95s. per ton has been shaded for mixed numbers, and in some cases makers have been willing to waive the shilling premium for No. 1. Still, 95s. per ton for mixed numbers and 96s. for No. 1 are the ruling quotations, and some makers ask more.

Iron-making Materials.

The foreign ore trade is lifeless. No more can be expected until the steel trade improves and more hematite furnaces are lighted up. Meanwhile, however, sellers seem to regard 27s. as rock bottom for best Rubio ore c.i.f., and 23s. 3d. per ton is an average figure for good Mediterranean ore. The price of good medium furnace coke varies from 27s. to 28s. per ton delivered at the works, but there is little business passing.

Manufactured Iron and Steel.

The position in the manufactured iron and steel trade already shows signs of improvement. No big orders have yet been placed, but there is a little more work in hand, and it is firmly believed that the price reductions effected this week will speedily attract more business. The fall of 10s. per ton in the price of plates, angles and sections is the first for eight months, and as consumers have now clearly nothing more to gain by waiting, they are not expected to hold back longer the orders which they have to place. There is the further factor that the appreciation of the mark and the costs of production in Germany have rendered German competition less keen, and there are brighter prospects of foreign business.

The Coal Trade.

The Northern coal trade shows little signs of improvement, and the outlook for the rest of this month is not very satisfactory. Business remains exceptionally quiet and devoid of interest. The orders in circulation just now are few and far between, and for any there may be in circulation for prompt deliveries the position is entirely in favour of the buyers, who are in a position to discount quotations. There is no great volume of inquiries from abroad. Preliminary inquiries are reported for about 20,000 to 25,000 tons of second gas coal; also 20,000 to 25,000 tons of unscreened coking for shipment to France from July to December. The Italian as well as the French trade has lately shrunk to very small proportions, while with the usual Scandinavian centres it is very little better. The colliery position is by no means uniform. A few of the pits are able to carry on fairly regularly, but many others in both counties, especially in Durham, are losing time very heavily. The market for best Northumberland steams is fairly good, and as a result of the curtailed production, smalls are also generally very firm, but in all other kinds, seconds and unscreened, there is very little being done. The Durham market, except for selected steams and the best brands of gas coals, is very shaky and irregular. Most of the fitters are having a very anxious time. There is next to no movement in the bunker coal trade. The demand is limited, and though the superior classes and first grades of ordinary are well over 20s., other commoner classes are pressed forward at discounted figures. The coke market is fairly steady throughout. Best beehive and patent oven foundries are in demand, while gas coke is also steadier and rather scarcer.

Northern Steel Merger.

A provisionally arranged fusion between two great Northern iron and steel companies—Bolckow, Vaughan and Co., Limited, and Redpath, Brown and Co., Limited—is announced. Under the proposed arrangement, which there is every reason to believe will soon be an accomplished fact, each of the companies will continue to carry on business under the same management as before. Bolckow, Vaughan and Co. were the pioneers of the iron and steel industry in the Cleveland district, and in addition to their iron and steel works at Middlesbrough and Grangetown they own iron ore mines and coal mines in North Yorkshire and South Durham. In recent years their

Cleveland steel works have been considerably extended, and all the latest plant and machinery installed. Redpath, Brown and Co. are well-known constructional engineers of high standing, and it is in connection with this work that Bolckow, Vaughan and Co. will benefit by the fusion.

SCOTLAND.

(From our own Correspondent.)

Still no Change.

ANOTHER week has passed without much sign of progress. Markets may be more hopeful, but definite movement is eagerly awaited. Time is creeping on, and if the latter half of the year is to be progressive, immediate action is imperative. At present, apart from labour troubles, other circumstances are apparently also working against producers. Prices are evidently too high, and consumers are firm in their intention to await easier terms. Rumours of orders are constantly going around, and if only a few materialise, buyers should soon be in full action again. There seems little doubt that business can be done whenever consumers are satisfied that a fair trading basis is offered. It is confidently anticipated that the accomplishment of industrial peace will be almost immediately followed by easier conditions in respect to prices. In the meantime, stagnation is rife in almost, if not all departments of industry.

"Restarting" Works.

Probably in anticipation of better times, some pig iron furnaces are to be restarted on a limited scale. Blast-furnacemen have been severely hit by unemployment, and even a partial restart will be welcomed.

Pig Iron.

The situation in the Scotch pig iron trade is without much change. Home demands have not expanded to any extent, though an improvement may be noted in the near future. The export department has been a trifle busier, but makers evidently have difficulty in securing profitable prices. Quotations have a tendency to harden, but it seems unlikely that any increase would be maintained. Hematite is doing little, the bulk of the inquiry being for foundry qualities for export.

Finished Iron and Steel.

Steel makers continue in a most unenviable position. They have lowered prices to something approaching a competitive standard without reaping almost any benefit. Home consumers are inclined to favour local producers, but they cannot afford altogether to ignore the prices quoted by continental makers. The latter are quoting about £9 2s. 6d. per ton delivered at local works, against £10 10s. per ton by home mills. Again, the continental f.o.b. price is £8, compared with £9 for similar material. There is a strong feeling that there will be more similarity between these quotations in the near future. Steel plates and sheets are stagnant, while only an occasional line in sectional material is reported. The demand for scrap is maintained, especially from the Continent, and firm prices are obtained. The position in the malleable iron trade is depressing, employment being most irregular. Home requirements, in particular, are small. The steel re-rolling departments, however, are showing a fair amount of activity. Quotations show little change, but in view of cheaper billets, makers are inclined to quote easier rates, and something less than £11 could be done for Crown bars for home delivery and £10 15s. per ton export. Black sheet makers also are disposed to make concessions in price, though the galvanised varieties remain firm. Export inquiries are improving, though the percentage resulting in actual business is small. New Zealand and Australia are more active, and other markets are beginning to open out.

Coal.

Development in the coal trade is slow, and the collieries in most districts are finding few outlets for their fuel. Local works have very few and small requirements, and municipal concerns are only taking immediate necessities. Household demands are at a low ebb, and prices are very unsteady, and vary between 1s. 7d. and 2s. per cwt. bag. Round coal is poorly bought, and there is therefore a scarcity of washed materials. The latter are still in good demand for shipment, and with a growing scarcity are firming up again. At the Lothians and Fife-shire ports a number of steamers are awaiting cargoes, but in the West of Scotland there was a drop in exports to the extent of 40,000 tons last week. Aggregate shipments for the week amounted to 286,743 tons, against 309,797 tons in the preceding week, and 307,379 tons in the same week in 1913. Apart from the quotations for washed nuts, there is no real stability in prices, and buyers with firm business for round coal can obtain concessions.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Situation.

THERE is not a great deal of life in the steam coal market, and it is with the utmost difficulty that coalowners can in most cases maintain the present reduced prices. Values have now got down to a level which is dangerously near compelling many undertakings to consider whether it is not advisable to suspend operations, as it is practically certain that there is no money in business at the prices ruling. The question was fully discussed at a special meeting of the South Wales Coalowners' Association on Friday of last week, when suggestions were put forward concerning the establishment of a schedule of minimum prices, but a strong difference of opinion existed regarding the practicability of this and other proposals. The meeting came to no definite decision, but asked the Commercial Committee to consider the matter further and to report to a future meeting. So far as the general inquiry on the coal market is concerned, there is nothing of very great account, and the prices that are obtainable leave no, or scarcely any margin of profit for those who undertake the business. The Midland and Great Western Railway Company of Ireland has asked for tenders for three, six or twelve months' supplies of best Welsh locomotive coal, and offers have to be sent in by the 19th inst. The Argentine Department of Navigation and Ports also requires tenders by the 23rd inst., through agents resident in the Argentine, for 25,000 tons of Welsh steam coal for delivery over five months commencing August, this being at the rate of 5000 tons monthly.

Industrial Depression and Its Causes.

Miners' leaders do not at all times give the help that they might do to remedy troubles and assist the industry to get over difficulties, and since writing a week ago the coalowners have had to take to task Mr. A. J. Cock, who, following a recent meeting of the Disputes Committee, made the assertion that Mr. Evan Williams, the chairman of the coalowners' side, had appealed to the men to join in a campaign to reduce the wages of the other workers, especially the railwaymen. This statement is described as a travesty of what Mr. Williams said, and naturally calculated to produce an impression utterly opposed to the intention of the chairman of the owners' side. The question of high railway charges and their incidence on colliery costs, and therefore on miners' wages, was under discussion, when it was suggested from the workmen's side that either the employers or the workmen would have to start a warfare, whereupon Mr. Williams explained, "We are quite prepared to engage in any warfare we can against the railway companies, and if you would give us your assistance we should be only too glad." Since then the secretary of the South Wales Coalowners' Association has given an interview regarding the present economic position in the mining industry, and after pointing out how the high rates of exchange are retarding the expansion of business, he states that the crux of the problem is the high cost of production, and particularly the high level of "other costs." In the South Wales coalfield these are now at about 7s. 6d. per ton compared with an average cost in 1914 of about 2s. 7d., and for this big increase the chief reason is the abnormally high cost of conveying coal from the pit-head to the docks and in the coveyance of materials for the use of the collieries. The cost of labour is also higher as a result of the shorter working day, and the lower output and the combined effect of these higher costs is to make the price of coal even at the recent reduced figures prohibitive to many industries. Mr. Gibson estimates the increase in the costs of the conveyance and shipment of coals as amounting in some cases to no less than 3s. 6d. per ton, or approximately 40 per cent. more than the whole of the "costs other than labour" in pre-war years, and nearly 150 per cent. above the railway rates in pre-war years.

Improvement of Cardiff Docks.

Coalowners and shipowners, and, indeed, all concerned in the trade of the Bute Docks at Cardiff, have agitated for years that the shipment facilities should be modernised and brought abreast of the requirements of the times, but the war, the question of finding the money necessary, and the high costs of the work have prevented the desires of traders being carried out. It has been estimated at various times that anything from half a million to a million of money was needed to put the docks in a proper state to cope with trade. One result, however, of the grouping of the railways under the Great Western Railway is the announcement that this company intends to take the matter in hand immediately. The company's engineers have come to the conclusion that the existing hydraulic system is out of date and not worth repairing. The directors therefore have decided to reconstruct entirely the hydraulic plant and equipment and to replace such coaling tips as cannot be repaired in order that the shipment of coals can be expedited. The cost of this work alone is estimated at £250,000, and the directors have voted the first instalment of £50,000 for this purpose. Tenders are to be invited immediately, and it is hoped that the work will be taken in hand by August 1st. It is proposed to construct four hydraulic pumping stations to give about 5300 horse-power, and capable of extension as found necessary, in place of the ten existing hydraulic stations which have a capacity of about 5000 horse-power. Three of the present stations will be utilised, but the plant will be substituted by modern equipment. The new central station will have electrically driven turbine pumps, one of 2000 horse-power, and energy will probably be taken from the Cardiff Corporation. As the work will take a rather long period it will be carried out in stages, and as the obsolete plant will not be discarded until the new plant has been installed, there will be no interruption in the working of the docks. Old tipping appliances will be replaced by new plant, and arrangements are being made for reconstructing the sidings and tip roads in order to bring about the highest efficiency and promptitude in the movement of traffic. Attention is also to be given to the import facilities, although these are pretty well up to date.

Tin-plate Workers' Wages.

At the annual meeting of the Welsh Tin-plate Joint Industrial Council, held last week, several claims for advances ranging from 10 to 25 per cent. on the present wage base rate were considered, but the employers intimated that owing to the depression in trade and unremunerative prices the claims could not be granted. The men's section therefore proposes reconsidering its policy.

Current Business.

The inquiry for steam coals continues very quiet, and this is especially the case so far as Italy is concerned. The state of the market is indicated by the amount of chartering of late, which has been very restricted. Many collieries have very great difficulty in effecting the prompt clearance of their stocks, and are not infrequently compelled to make some sacrifice in price to a buyer who can give them assistance. Competition for the little amount of business that is available is very keen, and many exporters are discounting present prices of coal, and even rates of freight in order to get foreign orders, although freight rates are now down so low that the amount of tonnage that is being laid up on account of trading being unremunerative is increasing. The wonder is that so many owners are still able to keep their boats running. Best Admiralty large is quoted at 26s. 9d. to 27s., and second Admiralty large at 26s. to 26s. 6d. Monmouthshire coals meet with a moderate inquiry and superior steam smalls are about 18s. 6d. to 19s. 6d. Patent fuel commands about 25s. to 28s., and foundry coke is steady. The anthracite market is firm except for duff coals. The demand for large and sized qualities is increasing, and two or three cargoes have been arranged for Canada and South America, and it is expected that further business will follow. Best machine-made nuts are firmly quoted at 57s. 6d. and cobbles at 60s.

Anthracite Colliery Development.

About twelve months ago, Sir David Llewellyn, Bart., and Mr. H. Seymour Berry acquired the Vale of Neath Colliery at Glyn Neath, and on Saturday last the former cut the first sod of what are to be known as the Maesgwyn Drifts, which are situated about half a mile to the west of the Vale of Neath Colliery. Each of the drifts is to be driven for a distance of 800 yards, and will pick up in its course the Four-feet, the Eighteen-feet, the Big Vein, the Pencoch and Bluers seams, all of which are in a virgin state. When the developments are completed in about two years' time, it is estimated that the daily output will be about 1500 tons.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Important Drop in Steel Prices.

CONSTRUCTION engineers this week welcome the authorised drop in rolled steel prices. It has been declared by the National Steelmakers Association, and becomes common, therefore, to all the steelmaking districts of the kingdom, including Scotland, Cleveland, Lancashire, the Midlands, Staffordshire, &c. The amount of the fall is 10s. per ton. The new prices for ordinary plates and sections now become: plates and joists £10, tees £10 10s., and angles £9 10s. Boiler plates form an exception. This material is reduced £1, namely from the former figure of £14 10s. to £13 10s. The reduction should assist construction engineers especially in the capture of foreign orders, and it is on this account that this class of consumer especially welcomes the drop this week. Billets and sheet bars are also easier this week, but of course not to the same extent by any means as rolled material. The utmost easing in billets and sheet bars is about 2s. 6d. to 3s. 9d., and possibly on some occasional sales 5s. per ton.

WALES AND ADJOINING COUNTIES.

Railway and Dock Charges.

The general committee representative of the Chambers of Commerce and traders has now agreed upon the case to be submitted to Mr. Felix Pole, the general manager of the Great Western Railway Company, for a further reduction in railway rates and dock charges, and has decided to ask him to receive a deputation next week.

Swansea Metal Exchange.

Tin-plates show a better tendency, the inquiry improving. Prices are steadier. The galvanised sheet market is also steadier. South America is inquiring for fairly substantial quantities.

Housing Scheme.

The Tredegar Iron and Coal Company is taking a prominent part in the Industrial Housing Association, formed to provide houses for colliery districts. The Association is to have a capital of one million and proposes to provide 10,000 houses, of which 2000 are to be built yearly for five years, a good percentage of them to be erected in South Wales and Monmouthshire.

THE ST. GOTHARD RAILWAY.—In the article on the completion of the electrification of the St. Gothard Railway, which appeared in our issue of last week, the statement was made that the maximum gradient was "about 1 in 4." This was, of course, a clerical error for "about 1 in 40." Actually the maximum gradient is 1 in 38.4.

CONTRACTS.—The Turbine Furnace Company, Limited, of 238B, Gray's Inn-road, London, W.C. 1, has secured orders, during the last two months, for the installation of its patented turbine furnace, covering amongst others the following industries:—Engineering, railways, transport, shipping, colliery, metal, chemical, gas, municipal (baths and bakeries), milling (flour and paper), brewery, and laundry.—Ruston and Hornsby, Limited, of Lincoln, have received from the York Waterworks Company an order to supply three double-cylinder Ruston cold starting oil engines of 160 brake horse-power, to be coupled direct to three high-lift pumps, each capable of an output of over 90,000 gallons per hour against a head of 200ft.; a double-cylinder Ruston oil engine of 100 brake horse-power, to be coupled to a low-lift pump with an output up to 300,000 gallons per hour against a head of 40ft.; and a single-cylinder oil engine of 15 brake horse-power, direct coupled to dynamo to give an output of 8 kilowatts.—In connection with the new graving dock now in course of construction at Durban by the Department of Harbours and Railways, the High Commissioner for the Union of South Africa has placed with the Engine Works Department of Sir W. G. Armstrong, Whitworth and Co. the contract for the supply and erection at Durban of two caissons for closing the inner and outer entrances of the dock with the hauling machinery complete. Both caissons will be of the rolling "box" type, the outer entrance being 110ft. wide by 47ft. deep, while the inner entrance is 110ft. wide by 49ft. deep.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	25/-
(1) Spanish	25/-
(1) N. African	25/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	27/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) **SCOTLAND—**		
Hematite	5 7 6	—
No. 1 Foundry	4 17 6	—
No. 3 ,,	4 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	4 15 0	4 15 0
No. 1	4 16 0	4 16 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS.		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 Fdry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 0 0	10 15 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	14 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 10 0 to 11 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	10 0 0 to 10 5 0	
Gas Tube Strip	11 0 0 to 11 5 0	
Hoops (*Nom.*)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) **SCOTLAND—**		
Boiler Plates	13 10 0	—
Ship Plates ⅜in. and up	10 0 0	—
Sections	9 10 0	—
Steel Sheets ⅛in. to ⅜in.	11 15 0	—
Sheets (Gal. Cor. 24 B.G.)	—	16 5 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 10 0	—
Joists	10 10 0	—
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 15 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	10 0 0 to 12 0 0	
,, (others)	11 0 0 to 12 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	£10 to 12	10 0 0
,, (Lancs. Boiler)	16 0 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0 to 11 0 0	
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 15 0	—
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 10 0 to 7 12 6	
Hoops	11 10 0	—
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0	—
Angles	9 10 0	—
Joists	10 0 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	150 5 0
,, (three months)	151 10 0
Copper (cash)	61 0 0
,, (three months)	61 7 6
Spanish Lead (cash)	24 10 0
,, (three months)	23 10 0
Spelter (cash)	28 0 0
,, (three months)	27 12 6
MANCHESTER—	
Copper, Best Selected Ingots	69 0 0
,, Electrolytic	71 0 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11½
,, Condenser	0 1 2½
Lead, English	26 5 0
,, Foreign	25 2 6

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£90	37/-
,, carbon free	1/1 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese	(per ton) £15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£24 10 0 scale 6/- per unit	
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£180	
Cobalt	12/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

	Export.
SCOTLAND.	
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	18 6
,, ,, Ell	19/-
,, ,, Splint	20/- to 22 6
,, ,, Trebles	20 6
,, ,, Doubles	19,6
,, ,, Singles	18/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	18 6
,, ,, Splint	20,6
,, ,, Trebles	20/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	18/- to 22/-
Screened Navigation	26/-
Trebles	20/-
Doubles	19/-
Singles	18 6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	19,3
Secondary Steam	18 3
Trebles	20 6
Doubles	19,6
Singles	18,6
ENGLAND.	
(3) **N.W. COAST—**	
Steams	33/-
Household	40/- to 52/
Coke	34/-
NORTHUMBERLAND—	
Best Steams	22 6 to 24/-
Second Steams	20,6 to 21,6
Steam Smalls	13/- to 15/-
Unscreened	20/6
Household	25/- to 28 -
DURHAM—	
Best Gas	22/6 to 23/-
Second	20 - to 21/6
Household	25/- to 28 -
Foundry Coke	32/6 to 35/-
SHEFFIELD—	**INLAND.**
S. Yorks. Best Steam Hards	22/- to 23/- —
Derbyshire Hards	20/- to 21/- —
Seconds	19/- to 20/- —
Cobbles	19/- to 20/- —
Nuts	18/- to 19/- —
Washed Smalls	11/- to 12/- —
Best Hard Slacks	12/- to 13/- —
Seconds ,,	10/- to 11/- —
Soft Nutty ,,	7/6 to 8 6 —
Pea ,,	7/- to 8/- —
Small ,,	2/- to 4 6 —
House, Branch	36/- to 37/6 —
,, Best Silkstone	34/- to 36/- —
Blast Furnace Coke (Inland and Export)	19/- to 21/-

CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	26/- to 26/6
Best Dry Large	25,6 to 26 -
Ordinary Dry Large	24/- to 25/-
Best Black Vein Large	26/- to 26/6
Western Valley ,,	26/- to 26/6
Best Eastern Valley Large	25,6 to 26/-
Ordinary ,, ,,	24/- to 25/-
Best Steam Smalls	18/- to 18,6
Ordinary ,,	15/- to 17/-
Washed Nuts	22 6 to 25/-
No. 3 Rhondda Large	28/- to 29/-
,, ,, Smalls	19/6 to 20/-
No. 2 ,, Large	23/- to 24/-
,, ,, Through	19/- to 20/-
,, ,, Smalls	15/- to 16/-
Coke (export)	34/- to 35/-
Patent Fuel	25/- to 27 6
Pitwood (ex ship)	31/- to 31 6
SWANSEA—	
Anthracite Coals:	
Best Large	47,6 to 50/-
Seconds	42,6 to 45/-
Red Vein	30/- to 32/6
Big Vein	42,6 to 47,6
Machine-made Cobbles	57/6 to 60/-
Nuts	55 - to 57,6
Beans	37 6 to 40/-
Peas	24/- to 28/-
Breaker Duff	8/- to 8/6
Rubbly Culm	16/- to 16 6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20 - to 22/6
Smalls	14/- to 16/-
Cargo Through	18,- to 20,-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Conferences.

THERE is a general impression that there would be an abundance of work for the engineering trades if only it were possible to settle upon some sound economic policy, and it is significant that the many conferences held to discuss the situation all arrive more or less at the same conclusions. The situation at the moment is such that it appears almost impossible to force a way through the entanglements of financial disorder and economic impediments. The engineering trades could obtain enough business if manufacturers could accept the prices offered, but so long as wages are influenced by the high rates paid by the State in the devasted regions, as well as by the fluctuating values of raw material, makers are unable to take orders that may entail loss, while in many cases they are not sure even of being paid. Quite a number of firms refuse to accept contracts for reconstruction work for that reason. They cannot wait indefinitely for payment. Business, in a word, cannot develop because there is a lack of confidence, and for some time past the feeling of attenuated confidence, which has manifested itself now and then, has perceptibly weakened, because it is becoming clear that nothing can be done without reforming the whole world's economic policy. Both at the International Parliamentary Commercial Conference and at the Money Congress held in Paris last week it was declared that there could be no salvation without complete commercial liberty. The State must abandon all interference with exchanges, and, while economising and reducing its fiduciary circulation, should do nothing to hinder the operation of the law of supply and demand. The Money Congress was particularly insistent in its demand for the abolition of fiscal restrictions of all kinds. The present method of fixing a sliding scale for wages according to the cost of living was also condemned as being contrary to elementary principles of economics. Wages must be paid by results. The men must produce more to earn more money, and by bringing down the cost of production the cost of living will fall proportionately. As a palliation for the present financial difficulties it has been decided to organise in Paris what is called "a short term exchange market," by which legitimate exchange rate operations would be controlled by a Board representing financial, industrial and commercial interests, so that the rates may be fixed for certain periods. A similar market has been in operation at Antwerp with highly satisfactory results. It was stated that an organisation in Paris would make that city the leading commercial centre by enabling all those engaged in foreign business to carry out operations with the certainty that they are not running the risk of exchange fluctuations. If that can be done there will be already a solid basis for confidence.

Capsizable Ships.

At a time when freights were very high and the State sought to relieve the country of its dependence upon foreign bottoms for the transport of coal, orders were given out for the construction of a large number of colliers for traffic between France and England. So urgent was the work that contracts were distributed even before the necessary credits could be obtained, and it is affirmed that the venture has resulted in a loss to the country of something like sixty million francs. The ships were built to designs supplied by the Department of the Merchant Marine. Several of them are still under construction. The type is known as the "Marie Louise," and some time ago some very unpleasant rumours were in circulation about the unsuitability of the type. One ship was lost in a storm, a second turned turtle near Hull, and a third capsized off Ushant. This succession of disasters was of too much significance not to arouse severe criticism, and the Under Secretary of State for the Mercantile Marine decided not to allow the "Marie Louise" boats to leave the ports pending an inquiry being carried out by a Commission specially formed for the purpose. It is impossible to say yet what are really the defects of these vessels. There does not seem to be anything radically wrong with the design, and there is a growing impression that the danger arises from the arrangement of the water ballast tanks, of which there are five along the bottom of the hull and four others above the water line, the latter being divided longitudinally by bulkheads.

Wages.

The wages problem contains the elements of serious trouble in the future. The State started by adjusting wages to the cost of living, and so long as wages are kept at an artificial level there is no chance of the cost of commodities coming down, and as, at the same time, foreign competition is lowering the prices of manufactured goods, makers are unable to pay the present high rates of wages if they are to keep their works running. During the week a conference has been held at Douai between coal-owners and the men's representatives, when the situation of the colliery industry was fully explained. Foreign coal is being offered in the Nord at below the price of local fuel. Being unable to sell, the coalowners have been accumulating heavy stocks, and they informed the men's representatives that they must either accept a reduction in wages or work longer hours so as to increase the production for the wages paid. The men's representatives then left to consult their Union, but they made it abundantly clear that they would refuse any reduction in wages and would not, under any circumstances, permit of any tampering with the eight hours' day. One of the arguments put forward by the men is that miners are leaving the pits and are going into the building trades where they are offered higher wages for reconstruction work in the devastated regions. This confirms what manufacturers and others have long been saying that the present trouble arises from the high standard of wages fixed by the Ministry of the Liberated Regions with a view of attracting sufficient men for the work of reconstruction. The State is competing with private industry.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

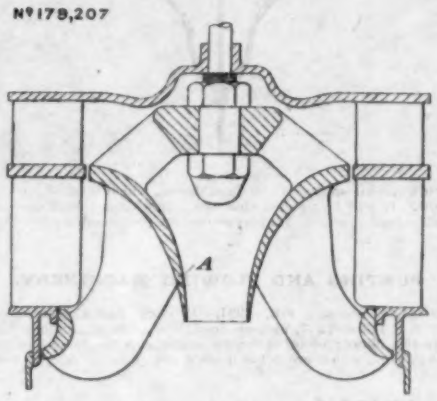
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

179,207. November 3rd, 1920.—LOW HEAD WATER TURBINES. *E. C. R. Marks, 57–58, Lincoln's Inn-fields, London, W.C.* 2.

The inventor endeavours to overcome the difficulty experienced with low head turbines subject to floods through loss of head caused by the tail-race level rising, by passing some of the

N°179,207



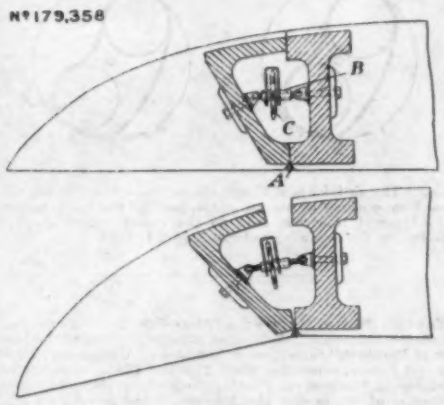
surplus flood water through an opening in the centre of the turbine runner. This nozzle-like opening is shown at A, and the intention is that the jet issuing from it should accelerate the tail water, and thus reduce its level. Alternative arrangements are also illustrated.—*May 3rd*, 1922.

AERONAUTICS.

179,358. February 28th, 1921.—AEROPLANE WINGS, A. V. Roe and Co., Limited, Newton Heath, Manchester, and R. Chadwick, Gwello Lodge, Bitterne Park, Southampton.

For the purpose of varying the camber of aeroplane wings, the inventors provide hinges in the wings, as shown at A, and alter the relative angular position of the parts by means of the

N°179,358



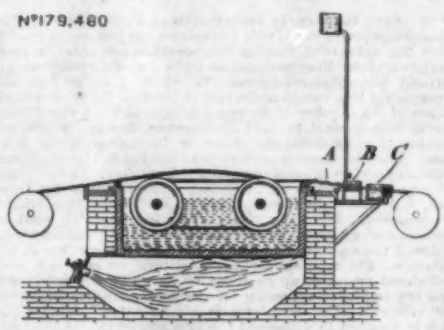
right and left-hand screws B. The screws are connected together by chains running over the sprockets C. The chains are led to the cockpit, so that the pilot can alter the camber at will.—*May 11th*, 1922.

ELECTRICAL APPLIANCES.

179,460. July 1st, 1921.—INSULATING ELECTRIC CONDUCTORS. *The British Thomson-Houston Company, Limited, 83, Cannon-street, London, E.C.* 4.

The inventors pass cotton-covered wires through a bath of asphaltum heated to a temperature of 500 deg. Fah., and then, after the excess asphaltum has been wiped off at A, through a

N°179,460

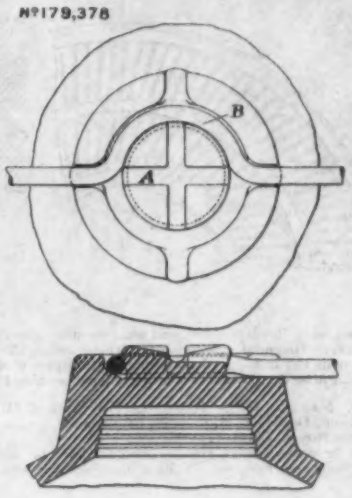


trough B of Chinese wood oil, which coagulates and forms a protective covering. Finally, the wire is coated with powdered talc at C to prevent tackiness. It is said that such conductors will withstand temperatures as high as 500 deg. to 600 deg. Fah. without damage.—*May 11th*, 1922.

179,378. March 15th, 1921.—INSULATORS, E. Parry, Third Floor, East Block, Caxton House, Tothill-street, London, S.W. 1.

With this insulator the conductor can be laid in place and put under tension before it is kinked to make it grip the projections on the insulator. A straight-through groove A is

N°179,378



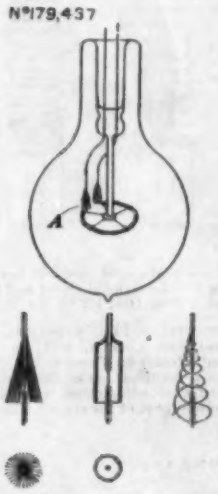
provided in the top of the insulator, in which the conductor is first laid. When the wire has been tensioned, it is lifted out of the straight groove, and put into the curved one B, when it is securely held by friction.—*May 11th*, 1922.

LIGHTING AND HEATING.

179,437. May 11th, 1921.—INCANDESCENT ELECTRIC LAMPS, Kazuo Kambayashi, No. 47, Ujicho, Kuze-gun Kyoto Province, Japan.

The inventor proposes to protect the joints in gas-filled incandescent lamps, where the filament is connected with the leading-in wires, by means of a sort of cage communicating with

N°179,437



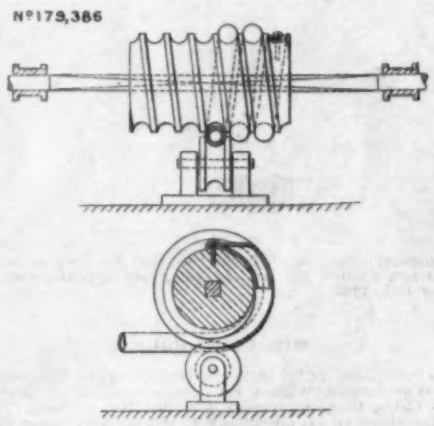
the leading-in wire. This cage, shown at A, intercepts any discharge which may take place between the terminals and prevents it from attacking the joints. Alternative types of cage are illustrated.—*May 11th*, 1922.

MACHINE TOOLS AND SHOP APPLIANCES.

179,386. March 22nd, 1921.—PIPE BENDERS, C. Zulver, 8t. Helen's-court, Leadenhall-street, London, and D. C. Endert, jun., Mathenesserlaan 226, Rotterdam, Holland.

In this specification a claim is made for "means for bending

N°179,386

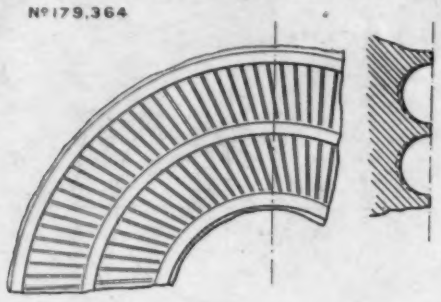


pipes or bars to form helical or the like coils, comprising a positively rotatable drum or cylinder formed with helical grooves on its surface, and having free longitudinal movement, and a rotary grooved guide or support mounted in a fixed position, over which the pipe or bar is fed into the helical grooves of the longitudinally slidable drum or cylinder." The drawing is self-explanatory.—*May 11th*, 1922.

179,364. March 2nd, 1921.—MANUFACTURING BALLS FOR BEARINGS, Rudge-Whitworth, Limited, and H. L. Heathcote, Rudge Works, Crow-lane, Coventry.

According to this invention, the roughly spherical blanks from which bearing balls are made are finished by being rolled

Nº179,364

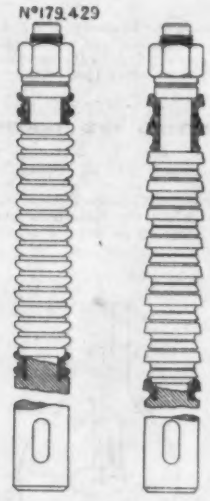


between plates having concentric semi-circular grooves cut in their faces. Diagonal channels are formed across the grooves, as shown in the drawing, by etching with cupric chloride and nitric acid after the plates have been hardened.—*May 11th*, 1922.

179,429. May 2nd, 1921.—BROACHES, J. Wakefield, 21, Chesnut-avenue, Derby, E. H. Cowgill, 64, Crewe-street, Derby, and Rolls-Royce, Limited, Derby.

These broaches, which are designed for both burnishing and cutting holes, are built up of conical rings and washers threaded

Nº179,429

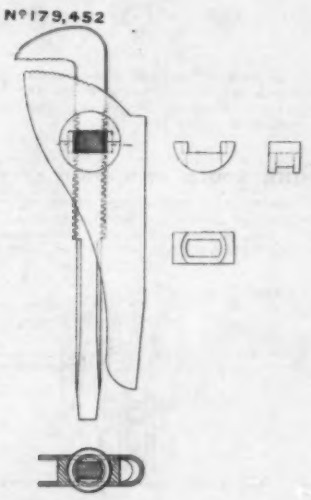


on to a stem. A nut is provided on the end of the stem, and can be used to flatten out the cones slightly, and thus increase their effective diameter.—*May 11th*, 1922.

179,452. June 9th, 1921.—PIPE WRENCHES, R. H. M. Lindley, 34, Englefield-road, London, N. 1, and T. F. Nash, 12, Vicarage-road, Henley-on-Thames.

This wrench is a modification of the familiar "Footprint." It will be noticed that adjustment is provided for by a nut working on a screwed part of the stock. The nut is housed in a

Nº179,452



cylindrical member, made in two halves, as shown by the detail sketches, so that the jaw can swing and grip the work.—*May 11th*, 1922.

MISCELLANEOUS.

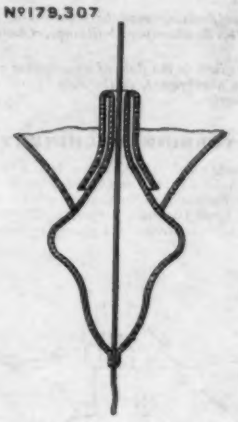
179,848. June 24th, 1921.—IMPROVEMENTS IN ELECTRICAL CONDUCTORS, William Puddicombe Granville, of Kelvin Lodge, Browning-avenue, Boscombe Manor, Hants.

The object of this invention is to provide a conductor with added inductance by a cheap and simple method and without unduly decreasing the flexibility of the conductor. A part of the surface of a conductor is first coated with a resisting or protective covering and then iron or other magnetic metal is electrolytically deposited upon the remainder of the surface. The protective coating may be applied as a thin spiral, in which case the electrolytically deposited metal will have the form of a tape wound upon the conductor.—*May 18th*, 1922.

179,307. February 3rd, 1921.—THERMIONIC VALVES, The General Electric Company, Limited, Kingsway, London, and C. F. Trippe, Osram G.E.C. Lamp Works, Brook Green, Hammersmith, London, W. 6.

In order to reduce the liability for the bulbs of thermionic valves to be damaged by a discharge taking place through the glass close to the leading-in wire, the inventors provide the wire

Nº179,307



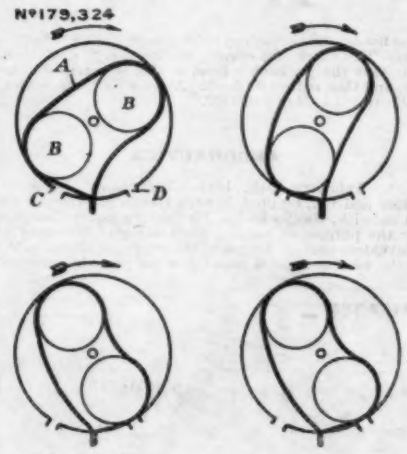
with a glass insulator of the form shown, which is fused into the globe. It will be noticed that the insulator is folded back on itself, so as to form an annular protecting space.—*May 3rd*, 1922.

PUMPING AND BLOWING MACHINERY.

179,324. February 8th, 1921.—ROTARY AIR COMPRESSORS, J. F. Palmer, 257, Victoria-road, Wood Green, London, N.22.

In this blower a loop of flexible material A embraces a pair of rollers B B, which are rotated on a spider inside a cylindrical

Nº179,324



casing. The air inlet is at C, and the outlet at D. The diagrams show how pockets of air are entrapped by the band and are carried round from the inlet to the outlet, where they are expelled by the following roller.—*May 8th*, 1922.

THE INSTITUTE OF METALS: AUTUMN MEETING IN SWANSEA.—As already announced, the annual autumn meeting of the Institute of Metals will take place in Swansea on Wednesday, Thursday and Friday, September 20th, 21st and 22nd. Members will assemble in Swansea on Tuesday, September 19th, during the afternoon of which day the honorary local secretary's office will be open for the distribution of papers and invitation cards. On September 20th, at 10 a.m., there will be an official welcome by the Mayor, and the remainder of the morning will be devoted to the reading and discussion of papers. After an official luncheon a visit will be made to the University College at Singleton, where tea will be provided. In the evening there will be a reception by the Mayor. On September 21st the morning will be devoted to the reading and discussion of papers, and after luncheon there will be visits to works, the evening being devoted to entertainment. A detailed programme of the meeting will be issued in due course. It is desirable to point out that only members and student members will be entitled to participate in the Swansea meeting, and that for the convenience of applicants for membership who are desirous of being elected in time for the meeting a special ballot is being arranged in connection with which membership application forms should be received by the undersigned not later than noon on Thursday, July 13th.

PORCELAIN INSULATORS FOR OVERHEAD POWER LINES.—The British Engineering Standards Association has just issued Specification No. 137—1922, dealing with porcelain insulators for overhead power lines. This specification is the first of a series covering overhead transmission line material which is in preparation. In preparing this specification the Committee considered that, in view of the number of designs available at the present time, none of which could be said to represent finality, it was not desirable to standardise the shape or dimensions of the insulators. The specification is therefore confined to the conditions of test and performance of the types of insulators. Considerable difficulty was experienced in finding suitable terms for these types, and finally the names "supporting" and "tensioning" were adopted. The term "supporting insulator" is used to denote one which supports the conductor, but is not intended to withstand the load attributable to the full tensile stress in the conductor. Pin type supporting insulators are generally used for declared pressures up to about 60 kilovolts and suspension types are employed generally for declared pressures in excess of 60 kilovolts. The term "tensioning insulator" denotes one which is designed to withstand the load attributable to the full tensile stress in the conductor. Tensioning insulators are of the disc and shackle type, but the latter is practically obsolete. Disc type insulators are divided into interlinked and metal hooded types. Copies of the specification may be obtained from the secretary, British Engineering Standards Association, 28, Victoria-street, Westminster, S.W. 1, price 1s. 2d. post free.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

MONDAY TO WEDNESDAY, JUNE 19TH TO 21ST.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Sessional examinations will be held in London, Manchester, Birmingham, Sheffield, Glasgow and Bristol.

TUESDAY TO THURSDAY, JUNE 20TH TO 22ND.

INSTITUTION OF MINING ENGINEERS.—Seventy-seventh general meeting at Sheffield. For programme see page 573.

TUESDAY, WEDNESDAY AND THURSDAY, JUNE 20TH, 21ST AND 22ND.

INSTITUTION OF GAS ENGINEERS.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Annual general meeting. 10 a.m. each day.

WEDNESDAY, JUNE 21ST.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Papers on "Light Signals," by Messrs. H. E. Fawkes and W. J. Sadler. 8 p.m.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.—9, Conduit-street, W. 1. "The Continuity of English Architecture," by Mr. W. H. Bidlake. 5 p.m.

WEDNESDAY TO SATURDAY, JUNE 21ST TO 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting and conference at Cardiff. For programme see page 570.

TUESDAY, JUNE 27TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Annual conversazione. 8.30 p.m.

THURSDAY, JUNE 29TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Natural History Museum, S.W. Annual conversazione. 8.30 to 11 p.m.

MONDAY, JULY 3RD.

THE ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly. General meeting. 5 p.m.

WEDNESDAY, JULY 5TH.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS: MANCHESTER CENTRE.—Visit to the works of the Partington Steel and Iron Company, Limited, Irlam, near Manchester. The directors of the company have courteously invited members to luncheon prior to the visit. It is suggested members travel by the 12.33 p.m. train from Manchester Central (C.L.C.) to Irlam, in order to be at the offices at 1 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are informed that the Société Anonyme Fama, of 8, Rue Blanche, Paris, now possesses the exclusive licence under the Riley patents to construct and install Riley stokers for Great Britain and its Dominions, as well as for France, and that a British company will shortly be constituted by it. Meanwhile all inquiries for Riley stokers should be addressed to Fama, 64, Mark-lane, London, E.C. 3.

W. M. SELVEY, Wh.Sc., M.I.E.E., consulting engineer, of Independent-buildings, Sheffield, desires us to state that on July 1st he is opening a London office at 23, Old Queen-street, Westminster, S.W.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, June 12th, Sir James Crichton-Browne, treasurer and vice-president, in the chair. Mr. H. Cooke, Mr. E. Davies, Miss Joan Evans and Mrs. A. Jacobs-Larkcom were elected members. The chairman reported the death of Ernest Solvay, an honorary member of the Institution, and a resolution of condolence with the relatives was passed.

DISSOLVED ACETYLENE.—With the idea of attracting the attention of the general public to the manifold uses of acetylene dissolved in acetone and stored under pressure in portable cylinders, Allen-Liversidge, Limited, of 100, Victoria-street, London, S.W. 1, have produced a cinematographic film showing the manufacture and use of the gas in a variety of different ways. This film was exhibited for the first time at a luncheon held at the Hotel Cecil on June 9th, and although the projector was evidently not in very good order, sufficient was seen to show that the film is of distinct interest to the non-technical public and specially so that part which had been taken with the ultra-rapid camera and showed the action of the blow-pipe on the molten metal in a weld.

INSTITUTION OF GAS ENGINEERS.—The following programme of meetings of the Institution of Gas Engineers, which will be held at the Institution of Electrical Engineers, Victoria Embankment, near Waterloo Bridge, has been arranged. On Tuesday, June 20th, at 10 a.m., after some preliminary business, the president, Mr. T. Hardie, M. Inst. C.E., will deliver an address and the annual report of the Council will be considered. A statement by the Gas Investigation Committee concerning research on aeration in atmospheric burners, and the seventh report of the Committee, "Carburetted Water Gas Plant with Waste Heat Boiler," will then be made, and the report of the Institution Gas Research Fellowship, "The Liberation of Nitrogen and Sulphur from Coal and Coke as Ammonia," by Dr. A. C. Monkhouse (Institution Gas Research Fellow) and Professor J. W. Cobb, B.Sc., F.I.C. (Livesey Professor), will be read and discussed. The report of the Life of Gas Meters Committee and the report of the Refractory Materials Research Committee, which will be presented by Mr. A. E. Broadberry, M. Inst. C.E., chairman of the Committee, and notes on (*a*) "The Thermal Conductivity of Refractories at High Temperatures," by Mr. A. T. Green; and (*b*) "The Standardisation of the After-contraction Test," by Miss D. A. Jones, B.Sc., will also be discussed. On the Wednesday, June 21st, at 10 a.m., after the annual meeting of contributors to the Benevolent Fund, a paper on "Some Gas Burners and a Moral," by Dr. Charles Carpenter, M. Inst. C.E.; a paper on "Increasing the Rate of Carbonisation of Coal," by Dr. Geoffrey Weyman, of Newcastle-on-Tyne; and a paper on "Reconstruction Work at Beckton," by Mr. W. B. Leech, will be read and discussed. On the Thursday, June 22nd, at 10 a.m., a welcome will be offered to the Société Technique de l'Industrie du Gaz en France, after which a paper on "A Recording and Integrating Gas Calorimeter," by Professor C. V. Boys, F.R.S., will be read and discussed. On Friday, June 23rd, a visit will be paid to the Beckton works of the Gas Light and Coke Company.